



EOS, Transactions, American Geophysical Union

Seismology

0950 Selamic Sources 5EISMIN'ITY AUD ASEISMIC SLIP ALONG THE ELTANIN FRACTURE ZONE SEISMITTY ALD ASEISMIC SUP ALONG THE ECTANN FRACTURE ZONE

L. M. Stevan (Department of Geological Sciences, Brown University, Providence, Rhode himd 02013; B. A. Okal

The sebmic story of the Elizain Tracture Zone or the Pacific-Anterctic Rodge for the years 1920-1981 shows that the seismic sign particular accounts for only a small fractical lines than 1972; of the amount of slap predicted by literants models of plate motion. We propose that the remainder of the plate motion along the stransform facile making up the Elizain system occurs as seismic energy. This property alagies out the Elizain system occurs as seismic energy. This property alagies out the Elizain system occurs as seismic energy. This property alagies out the Elizain system occurs in spinuic alip and predicted rates of mailor. The sheares of record of any glasmic carthquakes and the geometry of the fault area neduce the literature of the Elizain replacing along its reside length. We interprat the Elizain Fracture Zone in the light of an "aspectly" model, storying small, well-asparated aspectible for asymmetry model, storying small, well-asparated aspectible for a generated nature and creepilite behavior may be due to the presence of ercons mannes and possibly, local spredling, which could also be involved in the mechanism of generation of the Louisville Ridge. (Seitmicity, Creep, Fascius Zone, Houpots).

1. Geophys. Ras., Rad., Paper 1B1071

6958 Selante Sources
FOCAL MECHANISMS AND DEPTHS OF FARTHQUAKES IN
CENTRAL PAKISTANA A TECTONIC INTERPAETATION
R.C. Quiltimpre livoodwerd-Clyde Consultants, Wayna, NI
074751, A.L. Kaflos, and J.G. Armbruster
Focal mechanisms and depths for seven certiquakes in
central Pakisten were determined from an analysis of Reyloigh
verse of 20 to 50 see period. In eset-central Pakistan, the
endal planes for series celutions stribs obliquely to the grean
of surface structures. This observetice supports the
contention of other workers that o this rurkies unit,
decoupled from the beamment sing a surface of decoliment,
characterizes this segion. In wast-central Pakistan, reletive
movement between the indive and Eurosion plates in st lesset
pastiality accommodisted by estamin sitp elong the Cheman
butt. Other Galics pactially eccommodated by salamin slip elong the Charman built. Other feults, which are situated to the said of end its respectful to its Charman levil, may also take up some of the relative plate motion. Observed activity within the same of lowergent-type structure in central Publisham may be a result of the greater component of convergence server the indian-Eurasian plate houndary north of Guelts, Pakistan. (Surjece, ways, Pakistan, Letchnick). J. Geophys. Res. Red. Peper 35312

(Surjece wave, Pakisan, Lactople)
J. Goophys. Mes. Rad, reper 1873 2

by Sorlece Wave
hassuperents of Martie Maye Velocities and inversion
(so internal intermoderation and intermediate for the control of the control

Vol. 64, No. 41, Pages 585-592

expansion of rugionalized phase vetacities shows that they have t-2 variations that are similar to those of the twas-2 non-regionalized inversions. This means

They have t=2 variations that are similar to those of the L<sub>Max</sub> 2 non-regionalized inversions. This means that the regionalized on approach is appropriate on a lirar step lor studying istored horsengeneity of the Earth. Rower, the great circle phase veloc(ties are out sufficient, by chomestwee, to uniquely locate the learning the regionality. The same is true for tree cacification data. Upper wante, surface waves) d. Geophys. Ros., Red. Pepor 15/469

Solar Physics, Astrophysics,

7790 Techniques l'hese Corrention)

\*\*ADIOMERIC CORRECTION OF ATMOSPHERIC PATH LEME.

\*\*YLUCTUATIONS IN INTERFREMENTRE ETFERLESTS

\*\*G. N. Reach (Californic Sectitute of Technology,

\*\*Det Frogulaion Laboralory, Pesudese, Californic

\*\*Sitos], G. E. Rogs, P. J. Napier

\*\*To support Very Long Reselle to technology,

\*\*Despisente, the Jet Propulatou Laboratory has

daveloped e system for estimating etmospherio

\*\*Natur vapor peth delay. The system constitute of

that microways radiometers, one operating at 20.7

this and the other et 31.4 OHe. The seasured

el mospheric brightness temperatures at these two

irequencies yield the estimate of the

precipitable veler present is both waper and

droplets.

\*\*To determies the socuracy of the system; e

\*\*series of observations we undertakes comparing

the celepta of two water vapor resinuaters with

he phase sacietion observed with two composited

elements of the Very large Array. The results

shout (1) water vapor finatuatious decidents the

residual VLA phases and (2) the microwaya

reficular terms and correct these

radiometers can measure and correct linese effecto. The raw phase error elter correction to hypically is degrees at a wavelength of 6 cm, corresponding to an uncartainty in the path delay of 0.25 cm. The residual uncartainty is consistent with the stability of the microsave radiometer bet is emili occutderably larger than

and Astronomy

the elacitity of the VLA. The Lecthique is let successful under conditions of bears mixed. liteospheric path detay, interfercetty)

October 11, 198)

#### Volcanology

A699 Yolcanntugy (introsente Signala, fl Cattrel

00 ULILIATION OF SEISMICALLY RECORDED INFAMENTE

ACOUSTIC THAMALS TO MONITOR YOLCANDE EPROSIDE

FILL CLITCHON SEQUENCE 1082, A CASE INDE

F.J. Mank (Goophysical Research Deputant, below

footoch, 1001 hitch Rd, Garland, lares 1581)

Infrosonic-acoustic signals from five applicit

cruptions of El Chichne voltano during 28 Arri

through A April 1982 were recorded by a size
baragraph orroy and SRO solamograph collection

near McKinney, leass. Analyses of these signals from

through A April 1982 were recorded by a size
baragraph orroy and SRO solamograph collection

frequencies iros 0.0033 bertz to 0.055 bertz hild

frequencies iros 0.0033 bertz to 0.055 bertz hild

frequencies iros 0.0033 bertz to 0.055 bertz hild

frequency consistant with will be discussively

to 10 requency consistant with will be discussed in

to 10 requency consistant with will be discussed in

it is agreement with those theoretically predicted

in agreement with those theoretically predicted

sornalis [1971]. Estimation of linetic energy

releases by the explostogs at El Chichney synthetic

releases by the explostogs at El Chichney synthetic

series gruption on 4 April 1982 to 4.2. polity

largest gruption on 4 April 1982 to 4.2. polity

largest gruption on 4 April 1982 to 4.2. polity

largest gruption of 1 prediction of 1 predic nicrobarumetric erray data strangly recommended in control and the SRO (Seismic Research Observatory) and the SRO (Seismic Research Observatory) and the control of the stranglers provided data for lar-field analyses of valuable especially and coestruction of a rigorous volunte especially and coestruction of a rigorous volunte especially schip scale. (Infrasonic, El Chichen, Espiolity Schip scale.) J. Ceophys. Res., Red, Paper 361412

Ocean Sciences Meeting January 23-27, 1984 New Orleans, Louisland ABSTRACT DEADLINE OCTOBER 19. OCTOBER 19, 1983 Call for Papers (including abstract specifications) was published in Eos, April 5 and July 5

Preregistration Deadline January 6, 1984 Registration and housing information was published in Eos. August 2 For more information, write:

> AGU Ocean Sciences Meeting 2000 Florida Avenue, N.W. Washington, DC 20009 or call AGU Meetings Department 02-662-6903

WEEK

# The Geodetic Activities of the Department of Defense Under IGY **Programs**

Owen W. Williams and Kenneth I. Daugherty Defease Mapping Agency, Hydrographic/ Topographic Genter, Washington, DC 20315

The International Geophysical Year (16Y) pograms have special vignificance to gendesists. The IGY minessed the launching of the Just speade earth smellite and the beginning of the era of global geodesy. It is no worther that the U.S. Department of Delense (Hol)t with its the U.S. Department of Decease (1907) with the global geodesy requirements developed an early instead in satellite geodesy. Specifically, this led to be use of early satellites of opportunity (and subsqueatly of dedicated satellites) for world-wide assignion, geodetic positioning, and graving intentional satellites. In continuous with advantagement of the property of the satellites of the property of the property of the satellites of the sa eden atellite programs under the IGY. Dob paid a major role in the achievement of gendek gods perhaps for beyond that which was regioned originally. An early satelline program rathe project ANNA with the basic concept organing from the DoD. ANNA, a truly companie effort, involved the three delense servire NASA and other civilian agencies. 1 Miles eamples under satellite programs included may ramera and electronic measuring technious, especially the U.S. Navy's Dropplet syses, the Army's SECOR, and the pion elopment of laser illuminating and ranging experiment by the Air Force. On this our asion mailing the 25th anniversary of the HGY, this adderesals some of the Dol) activities of the hielyens that fulfilled the geodetic objectives of the IGY and highlights those activities that general of the IGY to become today's reclamble

#### Introduction

Any discussion of the U.S. Department of Defense participation in the International Geophysical Year (ICY) must begin by teralling the size of geordesy in 1957. Geordetic obenzions were generally limited to "line of ight." Coordinates of places, say, in North America were known relative to those in Eurasia to an accuracy of perhaps a compleundred meters or so. The carth ellipsoid dened by Hayford in 1910 had been named "International" in Martrid in 1924 and had been used to adjust the European Datum in 1950. The Poistan determination of absobe gravity and the International gravity locbut represented the state of the art in gra-

In the matter of education, prior to 1955, there were no Ph.D.-granting programs in godery in the entire western hemisphere. So, is not surprising that the U.S. Department of Defense (DoD), with its global requirement for geodetic and geophysical hilluma-ion, anomed a leading role in the programs of he IGY. During the cusming 25 years, Bob has dramatically demonstrated its serion commitment to the enhancement of genbut and geophysical knowledge ou an inter-national scale. There is little thaths that the present day wate of the art in georlede scithe own its existence in a large part to the efforts of the U.S. DnD. The long list of technological developments that received their impetes and funding from DuD includes such items at rocket flare triangulation (when he here attempting, in the early days, to tic disant land mouses together), the application of lunar occultations and solar eclipses for geodesy, sirborne gravimetry, the use of satelhas for surveying, the application of inertial technology to surveying, and many others.

The International Geophysical Year (IGY) regions, a truly remarkable scientific enterare and a cooperative effort shared by over nations, formally began on July 1, 1957. ading of U.S. Naval and Air Force aircrafts in McMutdo Sound and the opening of the Amundsen-Scott South Pole Station during October 1958 well in advance of the foll-scale ICI were clear indications of the faith, inter-S, and commitment the DoD in general had

The launching of the first mammade carth stellite in 1957 announced the explosive arms of the manner of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of the stellite in 1957 announced the explosive arms of hal of the "real" space age in geoclesy, and Dop developed an early interest in the resulting infant teience of satellite geodesy. Specifiolly, his led to the use of early satellites of opponunity (and subsequently of dedicated stellies such as ANNA, PAGEOS, GEOS, and the such as ANNA, PAGEOS, and the such as ANNA, PAGEOS, GEOS, and the such as ANNA, PAGEOS, stellies such as ANNA, PAGEOS, GEOS, and the Navy Navigation Satellite System) for sordwide navigation, geodetile positioning, and graylmeric investigations. The activities postering World Geodetic System (WGS) in 1960, defining a global geodetic network, gein conjunction, with other civilian satellite. programs under the IGY, DoD played a mafor tole in the schievement of geodetic goals

belyabe (as peaoud that which was envi-

sinued originally. An early start was the project ANNA. Other earlier satellite programs from DoD also included many camera and electronic measuring techniques, especially the U.S. Navy's MINITRACK and Doppler system (ut the Navy Navigation Satellite System, NNSS), the Army's SECOR (or Sequential Cullation of Ranges), and the Air Force's PC-1000 camera system. From a conservative objective of a 200-m navigational accuracy. the Doppler system onlay has become an extremely practical geodetic tool that routinely provides gendein network control of 1 m nr better accuracy over entire continents. And more, the Air Force's latest 18 satellite Global Positioning System (GPS) promises worldwide goedetic accuracies of subdecimeter level.

As part of the overall objective of the IGY gravity pringram, DoD has always played a major role in the extension and completion of a worldwide network of gravity measurements. From the initial measurement of neudulum bases for control purposes, the DoD ellort has been to comfact (esearch and develop better imtruments and to aid materially in eliminating the teriout gaps in the interna-tional network of gravity measurements.

More than 5 years of extensive planning

#### 2. IGY Activities

and preparation were devoted to the development of the 1957 IGV programs which were to become a concennation of intense effort to diminish great gaps in our knowledge of the planet carth and its turn unding regions. It should be remembered that the synoptic objectives of these programs also included siundemeous observations in most of the disciplines including polar, weather, solar, and ionospheric programs throughout the world. To achieve simultaneous observations, regular whedules were arranged through mernational enoperation. To achieve the desired intensification in the observational programs, Regular World Days (RWD) and Special World Intervals (SWI) programs were also designated. The driving motivation was that the resulting concentration of efforts under these programs would be useful in the interpretation of overall results.

II DoD was not in the larefrom in every program, it was there contributing one way or the other. Having had direct or indirect experience with these activities, we want to share with you the role that DoD played in the IGY programs.

#### Satellite Programs

The gemletic satellite programs and satellite gradesy grew out of the upper-nit tucket research activities, both during IGY and previous years. The Air Force Cambridge Research Center, now the Air Force Genphysics Lalauratury (AFGL), Army Ordnauce, Naval Research Laboratory (NRL), Navy Bureau of Ordnance, Hulloman Air Force Base, Naval Air Missile Test Center, and various U.S. Navy ships (e.g., The Compass Island) are some nd the DnD components that were in the forefront. Research rockets provided extremely valuable information regarding presure, temperature, density, and chemical and ionic composition of the aunusphere. They also yielded informating about winds, airflow, lonospheric charge density and refraction, so-lar radiation, and the enrth's magnetic field, in addition to being the forerunners of the satellite flights.

The IGY witnessed the launching of the first manmade carth satellite and the begin ning of the era of global geodesy. The use of satellites as additional tools in geodetic research and operations was immediately adopted universally, with the official endorsement for such a role coming from the International Union of Geodesy and Geophysics (IUGG) in 1960.

Our interest within DoD started with the use of early satellites of opportunity and then quickly turned into programs for the devel-opment of deilicated geodetic sajellities such

With the basic concept originating from DoD in 1958, ANNA (Arm), Navy, National Aeronautics and Space Administration, Air Force) was a truly cooperative effort and soon became the test bed for satellite geodetic methods. The extensive research and dedicatmemons. The extensive research and dedicated efforts of the three defeise services, NASA, the Applied Physics Laboratory (APL), and other civilian agelicles resulted in the faunching of ANNA 1A on May 10, 1982. However, the altempt to place the first true geodetic satellite that orbit failed when the second stage rocket engine did houghnie.

Thus, ANNA 18/ latinched bin October \$1.

1982, has the distinction of being the first

geodetic satellite.

The basic mission for ANNA 1B was or intprove existing geodetic control and to test and compare the performance of other bothcoming systems such as a transponder from the Army's SECOR, llashing lights for the Air Force's PC-1000 camera, NASA's MINI-TRACK optical tracking system (MOTS) camera, and the National Geodetic Survey's (then U.S. Coast and Geodetic Survey) BC-1 camera and a Doppler beacon for the APL and Naval Weapons Laboratiny (NWL) mack-

#### 3.2 The MINITRACK Systems

Prior to the launching of U.S. satellites under the IGY programs, NRI, had already established MINITRACK nations, The first satellite, Explorer I, launched in 1958, was a joint venture between the Army Ballistic Missile Agency (BMA) and the Jet Propulsion Laboratory (JPL). The second satellite, Vanguard 1, was sponsored by NRL, and the third was again a joint effort of BMA and JPL. These two satellites followed within the next 2 months the launching of Explorer 1.

Even in those early years, the Vanguard satellites were associated with an orbital lifetime of at least 200 years. It was also expected that these satellites with their spherical shape and stable uthits would prove very useful in geodetic and air ilensity studies. Of comse, not all those expectations became realities, but the Vanguard IGY satellite program definitely succeeded in laying slown a sound foundation for the other projects to

NRL's MINITRACK system became so deuse during the early years of this program that it created an electronic "fence" about the 75th west meridian, which every satellite had

Under the Vanguard 1 satellite program the comparatively inexpensive MINTRACK Mark II (developed from Mark I) ultimately became operational and was later routinely used by NRL for tracking and obtaining useful data for orbit computations.

#### 3.3 PC-1000 Geodetic Camera System

The development for this camera system began treat the end of IGV activities at AFCRL. This Air Force system had a lens with a local length of about 1000 mm, and hence the name. Its chopping shutter allowed observations of the flathing lights from ANNA 1B (section 3.1) or subsequent geodetic artive satelliter like GEOS 1. This thutter performed equally well with the passive satellites such as EUHO or PAGEOS, which followed later. The PC-1000's were complemented and augmented by the BC-4 camera system employed by the National Geodetic Survey (then Coast and Geodetic Survey).

There cameras were utilized for long range space triangulation for global/continental geodetic control networks. One such network, extending from Curacao to Asuncion, which can be ennumendably mentioned here, provided much needed control over South

# 3.4 Navy Navigation Satellite System

The concept for the Navy Navigation Satellite System (NNSS) or the Doppler system became a reality in 1958. By 1959 the experi-mental satellite TRANSIT IA and five tracking stations had been designed and

Although the TRANSIT IA satellite failed to achieve orbit, a full development program for the system officially began in 1959. The program's success started with the next satellite TRANSIT IB (launch date of April 15, 1960) and continued with followops like transit 2A, 3B, 4A, 4B, 5A, etc. The Doppler systen witnessed another threshold with the generation of new drag free satellites, the first of which was NOVA I (launch date of . July 1981). The accuracy improvement has been pitenomenal from the modest goals of about 200 m of the earlier years. The Doppler system of today has become one of the most efficient, accurate, and practical geories ic tools for routinely providing georles trol of 1 m or better accuracy, both for ludividual stations and/or as part of n station petwork that uses ground equipment such as the

#### 3.5 Geodetic SECOR System

The concept for this system also originated near the end of the IGY years and the first transponder went into space with ANNA IB (section 3.1). The system was based on the solution of a ground-based four-station tracking pyramid with the satellite transponder as the vertex in space. Over the duration of the SECOR system, an equatorial belt of tracking stations was established. Many of the stations were collocated with BC-4 stations, thus providing additional scale to the PAGEOS net-

After the first SECOR transponder was carried in ANNA 1B, the Army launched additional high and low altitude satellites for the SECOR system between 1964 and 1970. The system was then phased out owing to the high cost associated with the operational methods.

#### 3.6 Other Systems

The first Baker-Nunn caniera of the Smithsonian Astrophysical Observatory was installed at Organ Pass, New Mexico, on Noveniler 15, 1957. Shortly thereafter the U.S.-IGY pringram entablished 12 worldwide Baker-Nunn tracking stations. In this extensive optical tracking program, DoD was there to provide valuable logistic and operational

The 1959 lota satellite was placed in orbit by the Army Ballistic Missile Agency as a contribution to the 1959 extention of the IGY. the International Geophysical Cooperation 1959. It turned out to be the last satellite of the IGY programs. The viral initial tracking of 1959 luta was accomplished by U.S. Army Microlock stations in the Usited States and

Another satellite program worth mention-ing was NRL's Solar Radiation Measuring Satellite or "Sonray." This satellite was carried in a "piggyback" mode with the TRAN-SIT HA vehicle of the Doppler system. Although the project was of primary interest to geophysicists, the ionosulteric research also contributed information of value for geodesists about accurate orbit computations.

#### 4. Satellite Geodesy

If the concepts and the groundsonk for the era of satelling geodesy had been laid hefine the IGY years through research rockers, the results of geodetic importance came after the lanuching of the first manmade earth satellite. It was the ream of DoD scientists headed by John O'Keele in 1958 that determined the first definitive result of 1/298.3 for the earth's flattening by using the Vanguard sat-

From the investigations regarding variations in the orbit of Vanguard 1, DoD war again in the forelrout to suggest a modification to the traditional concept of the earth as a rotational ellipsoid. The calculations established the existence of a third zonal framouic, which in turn required a triaxial ellipsoid with an elliptic geodetic equator and the earth's shape somewhat sevembling a pear.

Even if the georletic activities under the IGY did not provide all the solutions, the research originating under IGY programs be-came the foundation of achievements that followed in later years. A striking example here would be the NNSS or the Dopplet efform It would be inmossible, in the allocated time and space, to describe adequately the achievements in this area. However, once the navigational requirements were satisfied. TRANET observations of the Doppler shift were milized over the years for continuous improvement of our knowledge of the geo-

Article (cont. on p. 596)

Owen W. Williams received his B.A., with honers, from Kalamazou College, Michigan, in 1948 and completed postgraduate studies at George Washingion University, Washing. ton, D.C., in 1951. He hor sirved as a visiting lecturer in Earth Sciences in Ev-

rope and Scandinavia, and in 1967 he was guest lecturer on "Cosmic Geodes" at the request of the Soviet Academy of Sciences. He retired from the U.S. Government in August He retired from the U.S. Government in August 1982, having served in numerous progressively responsible positions culminating as Deputy Director, Management and Technology, for the Defense Mapping Agency (DMA), the highest civilian pasition in DMA. He has anthored over 45 scientific and technical papers, which have been published in national and international journals in the fields of geodesy, gravity, and geophysics.

Kenneth I. Daugherty received a B.S. in mathematics, geography, and ge-dogy from Morehead State College in 1957; an M.S. University in 1961; Filosohe Linentiate in 1972; and a Ph.D. in grodery in 1974 from Uppsala University. He joined the Air

Force Aeronautical Chart and Information Center in 1957 and held a variety of line and staff posilions there. During this time he worked on pioneer efforts to establish the role of geodetic and geophysical support for bollistic missiles and was a member of USAF Science Advisory Board ad hoc group on geolesy and geophysics. From 1967 to 1974 he was associate professor of geodesy and assistant director of the Flavaii Institute of Geophysics, conrector of the Hawaii Institute of Geophysics, conducting research in physical geodesy, satellite geodesy, and marine geodesy and geophysics. During 1971-1972, he was a student and a visiting scientist at Geodetic Institute, Uppsala, Sweden, In 1974, he joined the Defense Mapping Agency as chief, Department of Geodesy, DMA Topographic Center: From 1975, to 1978 he was on Headquarters DMA at 6th Store 1920 he has been the technical ters DMA staff, Since 1979 he has been the technical director of the DMA Hydrographic Topographic Conter, Kenneth I. Daugherty is assistant-secre-tary of the International Association of Geodesy. He is recipient of the USAP Meritorious Civilian Seruice Award and the DMA Distinguished Civil-

ian Service Award.

593

# The VGP News



"Mind and Mallet and Crucible" [Originally appeared in The Geochemical News, 9, 5,

Faliton: Bruce Doc, 11721 Ory River Court, Res-ton, VA 22001 [telephone 703-860-3470, after 5:30

## News & Announcements

#### Travel Grants to IGC

The U.S. National Committee for Geochemistry is seeking lunding for its Travel Grant Program to the 27th International Geological Congress to he held in Moscow August 4-14, 1984. In cooperation with other organizations, the enminittee seeks to ensure appropriate U.S. participation by providing 10-20 travel grants to enable geochemists residing in the United States to attend. Travel grants are to be awarded based in part on a screening subcommittee's ranking of abstracts submitted for presentation at the ouigtess. Special consideration will be given to younger geochemists and those judged to benefit most by participating in this important international congress.

To apply, send six fastened-together sets of completed applications, including completed form and abstract (900-1200 words) of paper to be presented, to W. L. Petrie, USNC/Genchemistry, NAS-NRC, 2101 Constitution Ave., Washington, DC 20418 by January 31. 1984. (Firms available from Petrie.) Travel grantees must use U.S. flag carriers wherever possible and most lile a meaningful trip report before October 14, 1984.

Depending on the availability of funds, travel grant awards may be made by May 1, 1984. However, caucellations and other factors may delay a few grant awards to as late as August 1, 1984, or possibly after the con-

#### **Research Grants** Announced

Kraeger Emerprises, Inc., has annouced the winners of its 1983 Geochron Research Competition. Two awards were granted to sopport research proposals in each of the folwing areas: K-Ar dating, C-14 analyses, and Stable Isotope Ratio Analyses (SIRA).

Winners in the K-Ar dating area, their school, and their research topics are James J. Hardy, Jr., Northern Arizona Univ., The use of the 13-Ar method to date a major thrust event in west-central Arizona; and Christopher S. Lynnes, Univ. of Michigan, Correla-

by P.N. Mayaud

From the Foreword:

Geophysical Monogroph 22

Explains it all.

". . . Ihla book will surely be recognized in

tho years to coma as a classic. Sciontials

phonomana, solar octivity, ole.) will find

that this monograph contains all that

they need to know alloot any of tha

geomagnatic todices that may interest

Amorioan Geophysical Union.

Alexandar J. Dessler

In diverse fields of research laurorel

Derivation, Meaning, and Use

of Geomagnetic Indices (1980)

tion with age of magnetization in Cambro-Ordovician intrusives from Colorado.

In C-14 analyses: Kee Hynn Kinn, Florida State Univ., Cross-check of uranium-series disequilibrium ages by radiocarhou dating: Manine phosphate nodules and their associated sediments; and Charles K. Paull, Scripps Institution of Oceanography, The origin of stratigraphic offsets in deep-sea cores.

In SIRA: Teofilo A. Abrajano, Jr., Washington Univ., Origin and significance of sulpliases in selected mantle assemblages; and Virginia B. Sisson, Princeton Univ., Oxygen isotope work on the Ponder phiton and associated tocks.

According to Krneger, the awards, which amount to about \$1500 worth of analytical services for use in the research, are to be neade again in 1984 in the same three areas as well as in Rb-Sr or U-Pb analyses. More information may be obtained from Kreuger Enterprises, Inc., 24 Blackstone St., Cammidge, MA 02139 (telephone 617-876-3691).

# Meetings

#### Cosmogenic Radionuclides

Cosmic rays interact with the earth's atmosphere and surface to produce the "cosmogenic" muclides. In many instances the radioactive ones are readily distinguished from the anthropogenic and meteoritic backgrounds. Measurements of these cosmogenic radionuclides (RCN) can contribute to the solution of a variety of geophysical problems [Lal and Pe-tos, 1967]. Recent progress in this area was discussed at a symposium entitled Application of Cosmic-Ray-Produced Nuclides in Geoplivsics lick! May 30, 1983, at the AGU Spring Meeting in Baltimore [see Eos, May 3, 1983, pp. 282-284, for the abstracts]. We summarize here the symposium presenta-

The RCN accumulate differently in different terrestrial reservoirs. Table 1 shows some estimated global production rates and abundance levels for selected samples. In relatively simple collectors such as ice, the measurements may shed light on variations in production rates. In other collectors such as manganese modules the observations may tell more about the object than about cosmic raya, Accordingly, we divide the following text into two sections. The first summarizes symposium cootributions that emphasized cosmic ray histories and the second those that focused on the sample. Where the distinction blurs, the two sections overlap.

#### Cosmic Ray Variations

The total flux of solar and galactic cosmic ray particles determines the production rates of the RCN. J. R. Jokipii reviewed the types of temporal variability exhibited by the cosmic-ray flux. He noted the absence of large (>3-fold), lung-term (105-105-years) variations that might be associated with galactic processes. Changes in solar activity are known io induce shorter-term variations. Of special interest here are (1) the 11-year solar cycle which normally gives rise to 25% changes in the cosmic ray flox and [2] a "cycle" lasting perhaps 200-400 years during which the flux may increase by a factor of 2 or 3 in response to solar modulation. Superimposed on the above is a cycle of about 104 years attributed to changes in the geomagnetic field [Bucha, 1967]. Direct observation of the sun has established the 11-year solar cycle and shorter

ents a historical review

E92783

of Indicas officially racognized by the

This dafinitive resource taxi provides all

\$26.

accepted.

AGU membars receive 80% discount

Orders under \$50 must be prepaid

Inlamational Association of

scientisis with a thorough

geoniagnetic indices.

alalo-of-line-art description of

• itardbound • 154 pp • 28 tables

fully referenced and indexed

Gaamagnotlain and Aaronomy.

# TABLE 1. Cosmogenic Radionnelides In Selected Samples

lsotopc	l <sub>1/2</sub> , years	Production rate, athin cin <sup>-2</sup> s <sup>-1</sup>	Sample	Concentration,
14C 16Cl 25Al	$2.7 \times 10^{2}$ $5.7 \times 10^{3}$ $3.0 \times 10^{5}$ $7.2 \times 10^{5}$ $1.6 \times 10^{6}$	$^{5} \times 10^{-7}$ $1.57^{+}$ $1.1 \times 10^{-3}$ $1.1 \times 10^{-4*+}$ $2.1 \times 10^{-2*+}$	Scawatec Corals Grandwater Ice Tektites Rain Soils Lavas Phosphorites Aln modules Petraleum	6 7 × 10° 10° 4 × 10° 2 × 10° 1.6 × 10° 10° − 10° 5 × 10° 5 × 10° 5 × 10°

\*Staires [1980] \*\*Revss et al. [1981].

term variations, namely burbling and gusting of the solar wind, Forbush decreases, and solar flares. Measurements of the RCN may supplement these incastrements. They take on primary importance as we go further back Sample Oriented Studies

#### 14C in Carals

E. Druffel summarized some studies of 14C. especially in corals. The 11-year solar cycle leads to calculated variations in the 14C/12C ratio too small to detect with available methods. Variations in 14C/12C ratios with a period of 200-400 years have been docomented in several laboratories. Druffel has shown that corals that grew during the "little ice age" have elevated 14C contents.

There are three questions now under study. [1] What is the relationship between climate and solar activity as recorded by RCN's? Present evidence is contradictory. (2) To what extent do oceanic circulation patterns influence the 14C/12C ratio of the atomsphere? Evidence from corals suggests that the effect is small. (3) Has 14C production and its exchange rate between air and sea changed much over the last 60,000 years? At present, inknown factors cause 14C ages to be 10% younger than U-series ages of Pleistacene samples. The difference could reflect cither an increased 14C production rate or a lower partial pressure of CO2 in the atmo-

K. Nishiizumi determinations of longerlived cosmogenic radionuclides in ice. Unlike soils or sediments, ice cures provide samples minimally diluted by stable isotopes that may interfere with measurements. In favorable cases ice cores give sharp temporal resolution. 100. On the other hand, the RCN deposition rates can vary in response to atmospheric processes that may be only proorly under-strod. One way to test the lidelity of an isotopic record in ice is to compare it to one in-

ferred from 14C. on 18O studies. Measurements of both 14C and 10Be in the Dye 3 ice core correlate well with sunspot activity subsequent to 1950. The 10 lie contents vary by a factor of two. Carban-14 contents change less because the isotope's kinger atmospheric residence time damps ascillations due to production rate variations. For the period prior to 1950 agreement between the 14C and Be sonspot records deteriorates for unknown reasons. Raisbeck et al. (1981) analyzed 10Be in the Dome C ice core and found that samples deposited during the Maunder minimum had elevated 18 contents as expected. Raisbeck et al. [1981] and Oeschger and coworkers have reported increased <sup>10</sup>Be concentration during the last ice age. The <sup>10</sup>Be profiles correlate well with <sup>18</sup>O results. It is not known whether the enhanced <sup>18</sup>Be deposition reflects lower precipitation rates. changes in atmospheric circulation patterns

or a higher production rate. Finally, Nishiizumi summanzed recent progress in the 10Be/36Cl dating of ice samples. Relative ages for two samples A and B can be calcolated by assuming a constant <sup>18</sup>Be/<sup>36</sup>Cl ratio in precipitation and the absence of radionaclide transport in ice. With the adoption of a modern <sup>10</sup>Be/<sup>36</sup>Cl atomatom ratio of 8, Nishiizumi concludes that near-surface ice from the Allan Hills region of Antarctica has an age of about  $5 \times 10^5$ 

10 Be in Lake Sediments

M. Wahlen reported the 18 Be contents of varved sediments from two New York State lakes with minimal bioturbation. The purpose of the study was to search for long- and short-term variations in the rates of production. The 16Be floxes calculated for Green Lake are divided into three periods: a base-line period with low deposition rates (0.016 atom cm<sup>-2</sup> s<sup>-1</sup>), a period of enhanced rates. during the Sporer and Maunder minima (up to 0.1 atom.cm<sup>-2</sup> s<sup>-1</sup>), and the last 200 years or so during which <sup>10</sup>Be fluxes have steadily climbed toward a value near 0.8 atom cm<sup>-2</sup> The observations for the second period. match in size but not in temporal detail simi-

A. A. C. Markey

lar results from 14C. The recent increase in 10 Be deposition is attributed to increased soil

1aBe in Rainfall

Deposition rates for the longer lived RCX are not yet well known. O'Brien [1979] calculated a global average production rate of 0.025 atom cm<sup>-2</sup> s<sup>-1</sup> for <sup>10</sup>Be, while Rep. 8 al. [1981] estimated 0.021.

G. J. Stensland and M. C. Monaghan independently presented the results of several de terminations of loBe in rainwater. The authors designed the experiments to learn more about the factors influencing 10 Be deposition. Stensland's group deployed traps open only when rain tell. At one site (Bondsville, III.) the average monthly fall-out rate ranged from about 1 . 10 to 2 . 10 atom loBe g H2O. Values were highest from May to Azgust and lowest from October through March. The variations parallel those observed for Be. Stensland moted that the Ca contents of the rainwater samples indicate contamination by frue soil particles. Raintrops or said presumably lifted these particles into the air where they were entrained by raimbrops on their way to the collectors. The concentration of "He in the soil particles was not measured directly. Stensland estimates the contribution from this source may be as light as ~1 x 150 at lolle g 1 H21). This work demonstrates the need for care in the collection of samples

Monaghan attempted to estimate the annual global production of "He from neasurements of "Be and "Sr in rainwater, Each sample consisted of a year's precipitation collected at one of eight sites in the United States. Dust may have contaminated some samples. The observed, latitude-dependent lluxes of "Be were normalized to global out with the aid of the onSr measorements and the known global deposition rate of \*Si. With various assumptions and a theoretical correction for tropospheric production Moragham obtains a global production rate of about 0.018 at <sup>10</sup>Be/atom cm<sup>2</sup>. From a conparison of the different sites, Monaghan concludes that the lolle linx as measured by pre-Opitation at a particular location may not refably cellect the "lle prothiction rate.

#### 39 Ar in Seawater

R. D. Willis presented the first profile of 39 Ar in seawater. The 19 Ar half-life (269 years) makes this isotope important for treatments of oceanic circulation. The time scale for ventilation of the ocean is now estimated mainly from determinations of the less senitive "G. The anaples discussed by Willin were collected at depths between 0 and 600 m is the north Pacific (GEOSECS I). Each of the five samples weighed about 2 tonnes (f), was coonted for 2 months, and contained on the order of only 6 atom <sup>39</sup>Ar g<sup>-1</sup> H<sub>2</sub>O. The <sup>3</sup>Ar datom reported for 600 m differs significant ly from the prediction of a 14C box diffusion model. Three times lower than the calculated value, the observation soggests a removal rate of 19 Ar some 8 times faster than experied Samples from the lepths of 4000 m remain to be

### Sources of Atmospheric Methane

S. Hameed estimated from the carbon is topic ratios measured in atmospheric meth-ane the fraction of methane derived from (1) the incomplete combostion of fossil fuels. the partial burning of biomass, and (3) bane. rial sources. Blomass burning may be more important than previously realized.

L. Brown discossed progress in studying la Be in volcanic rocks. The primary purpose of this ongoing work is to demonstrate that island-arcilavas contain measorable traces of pelagic sediments subducted from the sea floor: Semiquantil saive estimates of the free tion of sediment-derived material present in sample may then be possible. Be act as good tracer for sedimentary matter for the following reason. Ocean sedbnents may con-

may also give information about the conditions under which deposition occurred. A. Alangini and coworkers studied a manganes crims some 20-40 cm thick stedged from a depth of 4830 m in the central Pacific. The measured the MBe and meral contents of 18 samples. A plot of <sup>10</sup>Be by depth suggests a two-stage accumulation history: an early one lasting from 11 to 6 nt.y. B.P. with a deposifrom the Alextians and Central America contion rate of 4.8 mm/MY and a late one with : tain between 2 × 106 and 5 × 106 atom 10 le slower deposition rate of 2.7 mm/m.y. The shift at 6 m.y. B.P. may coincide with a discontinuity in the & 13C record noted by oth-. Island arc samples from the Andes ers. With the aid of the growth rates, Mangini calculated dates for several petrographic mediate group: Most have low tolle contents and chemical changes observed in the enist, hat a few are similar to the Central American Many of these events apparently coincide has Brown prefers to defer comparisons of with changes in palenceanographic circulation inferred independently from the study of tenatics are more firmly established. For the deep-sea sediments. Mangini concludes that present he concludes that island-are layers do indeed contain <sup>10</sup>Be that once resided in pethe compact Alu nodules and crusts can pruvide paleuceanographic histories.

the up to 1010 atom "He g" I while igneous

should have virtually more. In the last year

Brown and his colleagues have doubled the

number of analyses of vedeanic rocks, bring-

ing the total to about 40. The experimenters

took pains to try in minimize contamination

from soil and rain. They divide their results

and hasalts have less than 1 × 100 atom

and the Far East seem to constitute an inter-

Ege with other elements until the 'lolle sys-

Uge in Phospharites, Mn Nodules, aml

C. Tuniz reported mensurements of talle in

marine phosphonies. The aim of the study

was to learn more about the timing of plan-

phone formation, W. C. Burnett and H. H. Veh have argued in several publications that

th disquilibrium dating supports a recent

102 x 105 years) origin for certain phospho-

Peru. Others have questioned this conclusion.

Tunz and coworkers showed that [1] plans-

nd (2) laminated phospharites with 234U-

Th top-to-bottom age differences of a few

thousand years have no 10 Be variability within

he 24(1-230 Th ages were valid. Two kinds of

ontes from Bone Valley, Fla., have

Be contents, consistent with radioactive

experimental error as would be expected it

blanks were discussed. Five million-year-old

deay, leaching, or a low initial complement

of Be it remains to be seen whether very

ter-borne infiltration. A negative linding

phorite origin.

would arengthen the case for recent plans-

Several graups have exploited accelerator

as spectrometry for the measurement of

Be and other cosmogenia radiomichiles in

mangarese northles and crisis. The results

may be used to calculate growth rates; they

The Weekly Newspaper of Geophysics

for speedlest reconstent of contributions send

the topics of the slouble-spaced manner ipt to

Elitor-In-Chiefe A. F. Spillians, Jr.; Editorse Mated Ackerman, Mary P. Anderson, Peter M

fisiery), Clyde C. Coad, Arnold I., Cardon, out J. Lanzerutt, Robert A. Phinney; Manag

g Editori tiregg Forse; Editorial Assistanti Sibken M. Lafferty; News Writori Barbara T

man; News Assistante Tenry Releasing

dection Staffe James M. Hebblethwalte, Itae

Sung Kim, Patricia Lichiello, Lisa Lichterratein,

Pass A. Van Allen, President; Charles 1.

rie, President-Elect; Leslie H. Meredith, steral Sectetary; Carl Klaslinger, Foreign Sec

for advertising Information, contact Robin E. Link, advertising coordinator, toll free at 800-424-2488 or, in the O.C. area, 462-6003.

opyright 1983 by the American Geophysical

ied by individual scientists for research or class-

nome ne. Permission is also granted to use shor quotes and figures and tables for publication in scientific books and journals. For permission for any other uses, contact the AGU Publication of the contact of the AGU Publication of the contact of the AGU Publication of the A

ient expressed in this publication do not nec-tarily reflect official positions of the American exphysical Union unless expressly stated.

cription price to members is included in an

Subscription price to members is included in an-nual dues (\$20.00 per year). Information on in-strational subscriptions is available on request. Second-class possage paid at Washington, D. C., and a additional mailing offices. Eas, Transac-loss, American Geophysical Union (ISSN 0096-394)) is published weekly by

American Geophysical Union-2000 Florida Avenue, N.W. Washington, D. C. 20009

over. Bounded on three sides by wa-

ter, San Francisco is a delight to travelera

Meeting, being held this year December 5-9. Housing reservation deadline is Normaline is November 1. Meeting preregistration deadline is November 10. See Housing and Registration forces in the least Photos.

Regulation forms in this issue. (Photo:

courtesy of San Francisco Convention & Visiors Bureau.)

增加分数

and is the site of the annual AGU Fall

Material in this issue may be photocop-

tear; A. F. Spilhaus, Jr., Executive Director, Waldo E. Smith, Executive Director Emeritus.

this T. McManigal.

cers of the Union

Sell (News), Bruce Doe, C. Stewart Collinior

old submarine samples contain 10 He from wa-

about twice as much as nearby sediments

ne collected off the coasts of Chile and

horites contain about 2 3 109 atom

batt coze.

o contrast, 10 non-island are layas and

intothree groups. Twenty of 21 samples

not more than n few million years old

Motivated by the lack of reliable isotopic techniques for the age-determination of petrolenin, F. Yion and coworkers have begin a survey of 10Be in various petroleum reservoirs. Oils nider than 25 m.y. contain no detectable 10 Be; crude oils thought to be 2-5 un.y. old have detectable quantities of 10 Be, 4 9 ≥ 10° atom g<sup>-1</sup>; a modern, hydrocarbonrich sediment contains 4 × 107 atom 10 Be g-1, some of which may attach to the clastic component. The authors note that many factors may influence the 10Be contents of crude ails, among them initial depositing conditions, exchange with water, sediments, reservoir rocks and kerogen, and migration his-

#### 18 Be in Soils

M. Pavich and J. Klein both reported on 16 Be measurements in soils. The multiple origins of soil particles pose a difficult problem for isotopic dating of samples more than 105 years old. It has been suggested that with suitable modeling, 10 Be incasurements may provide useful information about soil thronology. Pavich measured the 10 Be contents in soil columns from Merced River, Calif., terraces ranging in age from 0.04 to 3 m.y. As expected, total "le inventories increase with column age and thickness. For the oldest colnames, however, the standing crop of 10Be falls short of the amount anticipated based on current estimates of the deposition rate and the assumption of complete retention. From the shortfall the authors estimate a "fle residence time of 6 × 105 years. Monaghun et al. [1983] obtain a lower value of about 10t years from an analogous study of other soil colmms. Whether the discrepancy arises from sampling artifacts or site-specific differences is not resolved. Pavich notes a correlation between day and 10 Be contents in the soils.

Klein and coworkers have been studying crosion in various watershed regions by applying mass balance to <sup>10</sup>Be. They measure the <sup>10</sup>Be contents of sediments from rivers or on continental margins, multiply by the aediment thix, and compare the result with the fall-out rate of 10 Be over the watershed. In a few cases such as the Amazon and the Susquehanna rivers, 10 Be inflow and nutflow match to within a factor of 2. In many others such as the Mississippi and Yangtze rivers, "lle loss may exceed accretion by as much as a factor of 10. No "primordial" watershed has heen found to give a steady-state far 10Be. Thus, increased erosion due to agriculture may account for part but need not explain all of the net loss. Klein notes that, with a few exceptions, areas with the highest erosion rates produced sediments with the highest Be contents. The authors conclude that erosion tends preferentially to carry away particles rich in 10Be.

#### 36Cl in Groundwaler

The relative inertness of aqueous Cl renders it especially soltable as n hydrologic trac-er. Grundwater contains <sup>16</sup>Cl derived from three main sources: cosmic ray bombardment of the air and of rocks, activation of rocks by hission-produced neutrons, and bomb testing. With appropriate modeling the 36Cl co of groundwater systems give chronological and hydrodynamie Information. Accelerator mass spectrometry makes it possible to measure the low levels of <sup>36</sup>Cl encountered, S. N. Davis, H. W. Bendey, and P. L. Airey discossed the application of 35Cl measurements to the study of the Great Artesian Basin in Australia and to the Mllk River Aquifer In Alberia, Canada.

In the Great Artesian Basin, 36CI/CI ratios decrease systematically from the source to the discharge region. With minor exceptions, the isochrons mapped from the <sup>36</sup>Cl ages agree well with isochrons independently calculated from the known hydraulic parometers of the system. The authors interpret the agreement

system. The authors interpret the agreement as a strong endorsement of the assumptions of <sup>36</sup>Cl groundwater dating.

The Milk River Aquifer behaves differently: Cl<sup>-</sup> and <sup>36</sup>Cl contents increase with distance from the recharge or source region, while the <sup>35</sup>Cl/Cl<sup>-</sup> ratio decreases. The appropriate the consentration increases in while the \*\*CI/CI ratio decreases. The epithors interpret the concentration increases in terms of flow fill ration. The \*\*CI/CI ratios yield water ages that exceed estimates from numerical modeling, perhaps because glaciation interrupted the flow patterns for long the line. Some dilution of \*\*CI by conperiods of time. Some dilution of \*\*CI by contemporary dissolution of ancient chloride de-The state of the s

posits may also occur. This process, 100, would increase the calculated MCI ages.

10Be & 26Al in Impact Ejecta

The application of cosmogenic radiomiclides to the study of impact-produced materials was discussed by G. Raisbeck and F. Tera. Last year Pal et al. [1982] showed that australasian tekrites contain ~2 x 108 atom <sup>0</sup>Be g<sup>-1</sup>. They argued that the <sup>10</sup>Be and the tektiles formed un earth, but could not entirely exclude the possibility that a small extraterrestrial component, either lunar or me-teoritic, carried some <sup>18</sup>Be. If the <sup>10</sup>Be were extraterrestrial, however, the teknites would also have to contain measureable quantities of nther cosmogenic radionuclides such as 26Al and 12Mn. Raisbeck used accelerator mass specirometry to measure the 26 Al contents of several australasian teknites and other impacirelated objects. The 26Al/10Be ratios observed were consistent with a terrestrial bor not an extraterrestrial origin. These observation unambiguously rule out a lunar origin for tektites. Raisbeck also found that other impact-produced materials such as Libyan desert glass contain 26Al in amounts consistent with what cosmic rays would produce on bombarding terrestrial surface matter for ~107 years. He suggested, as have others, that the cosmogenic radionnelides may prove useful in the calculation of surface exposure ages of terrestrial rocks.

Tera presented the 10 Be contents of more than 20 australasian tektires and the 36Al contents of six. Again the 26Al/10Be ratios were terrestrial. Tera stressed the small range of values observed for 10 He, values which average about 2 × 10<sup>8</sup> arom <sup>10</sup>He g<sup>-1</sup>. Sediments harvested from confinental margins exhibit : similar, small range of 10Be contents. Soils, in contrast, have 10Be contents that differ markedly from location to location, ranging from 1 × 107 to over 1010 atom 10Be g ... Tera vig gests a continental margin for the site of the impace that produced australasian tektites. An origin on a continental margin would accommodate the dilbentty specialists have had in identifying a source crater: the crater would have been covered. A margin site may also Incuish material trom considerable deput with appreciable 10 Be content and thus would help explain the unitormity of the data.

my has greatly facilitated the measurement of such long-lived β-eminers as 36Cl, 26Al, 10Be, and 1291. The new technique obviates the need for fastidious radiochemistry, reduces by 1000 times the minimum sample masses. and gives results in hours rather than days or weeks of counting. Technical advances contime. D. Elmore pointed to prospects for measuring 41Ca and certain stable elements; for example, platimum. Accelerator mass spectrometry may prove helpful in the measurement of solar-neutrino-produced isotopes and in other problems in particle physics that have geologic detectors. Willis outlined progress made by Hurst and coworkers at Oak Ridge in the detection of SI Kr by laser-assist ed separation and mass spectrometry. The advance of resonance ionization techniquea promises a host of new applications.

The advent of accelerator mass spectrome-

K. K. Turekian sounded several cautionary notes. He pointed out that because local desition rates of the RCN may vary appreciably, certain investigations will require large numbers of measurements to establish clear patterns in the resolts. The high cost of usin the new measurement techniques militates against soch surveys except where na cheaper approach exists. Furthermore, gaps in our understanding of the geochemistry of the RCN and of the systems in which they are studied may cloud the interpretation of even the most precise resolts. For example, diffusion as well as successive laminar deposition may influence the 10Be contents of Mn crusts

and nodoles. The foregoing text indicates the wide variety of geophysical problems related to cosmogenic radionuclides. While the less well-10 Be, 26 Al. 39 Ar, 51 Kr, and 129 seem onlikely to challenge <sup>14</sup>C in importance, they occopy niches that <sup>14</sup>C cannut fill. We regard the study of to Be in volcanic rock as fundamental in Importance. The hydrogeological measurements of <sup>16</sup>Cl have begun to meet expectations. The analysis of cosmogen ic radionuclides in various terrestrial reservoirs augments our knowledge of sedimentary, depositional, and erosional processes.

Much of the work described is exploratory. We anticipate that rapid progress in the area

#### References

Bucha, V., Archaeomagnetic and paleomag-netic study of the magnetic field of the earth in the past 600,000 years, Nature, 213, 1005, 1967.

Lal, D., and B. Peters, Cosmic-ray produced radioactivity on the earth, in Handbuch der Physik, 46/2, 551-612, 1967.

Monaghan M. C., S. Krishnaswami, and J. H. Thomas, 10Be concentrations and the long. term fate of particle reactive nuclides in five soil profiles from California, Fath Plant. St. Lett., in press, 1983.
O'Brien, K., Seeplan variations in the production of cosmogenie isotopes in the earth's

atmosphere, J. Geophys. Res., 84, 423-431,

Pal, D. K., C. Touiz, R. K. Moniot, T. H. Kruse, and G. F. Herzog, <sup>10</sup>Be in aostral-asian tektites: Evidence for a sedimentary precursor, Science, 218, 787-789, 1982. Raisbeck, G. M., F. Yiou, M. Fruneau, J. M. Loiseaux, M. Lienvin, J. C. Ravel, and C. Lorius, Cosmogenic 10 Re concentrations in Antarctic ice duting the past 30,000 years, Nature, 292, 825-82B, 1981.

Reyss, J.-L., Y. Yokoyama, and F. Guichard Production cross sections of 26Al, 22Na, 7Be from argon and of 10Be, 7Be from nitrogen: implications for prodoction rates of <sup>26</sup>Al and <sup>10</sup>Be in the amosphere, Earth Planet. Sci. Lett., 53, 203–210, 1981. Stuiver, M., Solar variability and climatic change during the current millenium, Nature, 286, 868-871, 1980,

This separt was prepared by G. F. Herzog, who is with the Department of Chemistry, and T. H. Kiuse, who is with the Department of Physics, of Rutgers, The State University of New Jersey, New Brunswick, NJ 08903.

## **Opinion**

#### **Isotope Instrumentation**

Editor's Note: The following commentary is excerpted from the second preliminary report on isotopic instromentation in georbemistry and mineralogy ubmitted to the Intersocietol Committee on Instrumentation in Geochemistry and Mineralogy (ICIGM). The report expresses the opinions of one individual (BRD) and in no way is an official expression of the It.IGM. For n copy of the full repost write to Bruce R. Dae, 11721 Dry River Ct., Reston, I'A 22091.

#### Accelerator Mass Spectrometry

The Accelerator Mass Spectrometer (AMS) at the University of Arizona, built by General lonex on the Cockcroft-Walton principle, is reported by Paul Damon to be operating rontinely and well at 1.8 MeV. Radiocarbon ages that match or esceed the liest underground beta coming facilities are reportedly heing produced. Reproducibility is reported to be 1% a value Damon Jeels can be improved as they get more experienced in preparing and mounting samples. A second machine at the University of Toronto-built after the initial University of Arizona instrument—is rumored to be operating at 2.5 MeV and Damon is now checking this out. At Arizona they will now convert to riving chlorine-36. The price of the General Jones machines has risen to about \$1.4 million.

Cooperative research with many investigafors continues at the University of Rochester tandem Van de Graaf mass spectrometer of which, D. Elmore reports, 20% is funded to do earth science studies. This facility is the most versatile laboratory, with data on chlorine-36 in ice, as well as a variety of beryllium-10 studies, being published. Meyet Rubin has been doing radiocarbon studies there and reports that it is sufficiently well actomated that he can roo samples by himself so long as nothing gues wrong (i.e., in routine operation, one doesn't have to be an accelerator expert). Analytical uncertainties seem to be about 5% though Rubin feels he is getting about 3% data on radiocarbon. Elmore reports that other kinds of studies are planned ch as iodine-129. The tandem Van de Graaf mass spectrome-

ter at the University of Pennsylvania has been progressing well. Papers by Roy Middleton and colleagues, Loo Brown of the Depart-ment of Terrestrial Magnetism (DTM), and Milan Pavich of the U.S. Geological Survey IUSGS) and others have involved primarily beryllium-10 in soils and the most exciting paper on volcanic rocks; however, the first application paper by AMS on aluminiom-26 has also recently been published. Although this facility is not as well automated as the one at Rochester and must be uperated by accelerator experts, R. Middleton is known as the genios of sources (G. F. Herzog of Rotgers University refers to Middleton's "window maker" source as a real advance). Intensity has been increased by a factor of 50 since 1979. As of the time of this report, the University of Pennsylvania/DTM team has yet to sell an earth science proposal to NSF, so all studies so far are "bootlegged" nff of particle physics funding but with the knowledge of the funding agency. Small but important support is provided by DTM and the USGS. L. Brown reports that they can have excellent reproducibility on a given day (perhaps 0.1%) but reanalyses a few weeks inter may differ by

Herzog, at the Rutgers University facility has mainly published on extraterrestrial sampics but is also interested in lake sediments. and pelagic sediments and tektites. As of tho time of this writing, he has a grant covering

Time on the Yale taudem Van de Graaf mass spectrometer is severely limited and is bootlegged, but there have been some important papers by Turekian and colleagues on beryllium-10 in manganese nodules. I believe

VOP (contrair p. 596)

595

7

2000 Florida Ave., N.ty.

Washington, DC 20009

Call: 800-424-2488

A matter that needs mentioning is the itinerant U.S.-tion U.S. research efforts. The first paper reporting AMS radiocarbon dates recently appeared in Science. This paper was a collaborative effort by a physicist at San Jose State with the AMS group at the Swiss Federal Institute of Technology, T.-L. Ku and colleagues have been doing beryllinor-10 studies of manganese nodules with the Totonte AMS group. It appears to be difficult for all the U.S. scientists who wish to participate in the terrestrial cosmogenic radionurlide work to be involved with U.S. AMS facilities, but at least some of those being left out are being resourceful in finding collaborating facilities somewhere in the world. The problem is not restricted to the U.S. scientists. C. M. Raisheck of Feance-the person who started it all and had a 2-year head start—has not been able to get on French facilities, so has been collaborating with researchers as U.S. AMS facilities at the universities of Rochester and, more recently, Pennsylvania. Raisheck is now getting a General lonex machine, however.

Elntore has pointed out to me that the very important krypton-81 mot formed by spontaneous basion in nature, like chlorine-36) cannot be done by AMS methods because it does not form negative ions. An alternative, laserbased method is being worked on by a consortium involving Scripps, Bern, and Oak Ridge, G. Wasserburg points out that once improved electronirs are developed for the Cameca ion prohe, it should be ideal for cloing aluminimn-26, so AMS might not be recessary for it. Therefore, AMS facilities cannot do all the cosmagenic radionuclides, and the relatively less-expensive instruments like the ion probe may be suitable for some others. Althnugh the big tandem Yan de Graaf facilities are adequate for the time being to dn the first order studies in the frontier scientific area of terrestrial cosmogenic radionuclides, their expense (more than \$1000 per day) and lack of high long-term precision probably will render them unsuitable at some undefined date in the future. The relatively lowcost General lonex machine is not yet operat ing at the 3 MeV mentioned in the specs. Alternatives (desk top cyclotions of Muller, etc.) are not yet developed. Our problem, therefore, is two fold:

(1) We must get funds for terrestrial cosmogenic radionuclide studies, both for scientific investigations and for operation and derelopment of a few existing AMS facilities. Proposals in scientific exploration (where AMS has the best applications) receive hostile peer review in the earth science area of NSF, compared to the normal scientific engineering proposals (where you know a lot and can make a good case for the next surp); (2) We must develop less costly, more pre-

cise instrumentation over the next decade. As bootlegged research and research fintded by other agencies or parts of NSF spon-sored research by the Physics Division become published and terrestrial cosmogenic radionuclides begin to move into a less pioneering mode, the hostility in the peer review system of the earth sciences community in NSF may begin to evaporate. This development will stress existing NSF hudgets in earth science, especially as the interest of the Phys-

ics Division can be expected to wante. I am a little bit uncertain as to what is the proper thing to do for the next step. Certainy I am not comperem to render a Delphic decision. I think two things are needed, however: [1] a strategy on how to proceed over the next 10 years or so in this area and [2] some priorities as to where cosmogenic radianurlides should be, relative to the rest of geochemistry and mineralogy.

As for the importance of this research area, I quote from the previous report of June 16.

This frontier area of geochemistry is not only exciting-for example, it appears from Be-10 studies that sediments are being subducted in many areas—but has great application to societal goals as well. These applications extend from the dating of mineral deposits linany phosphorite de-

posits thought to be Recent are gradually 200,000 km² of the E region over muthern shown to be Miocene, but they are difficult to date) to the already mentioned ground water dating for waste storage to ground stability evaluation. In ground stability there is the dating of both sediment and sedimentation rates, evolution of soils, and clating exposure ages of target rocks. One of the most difficult dating areas involve torrential flooding and land slides and de termination of recurrence intervals. Expo sure ages are a good way to get at this if the technique works. 1091, 1978). In spite of the difficulties, there are an in

pressive amount of research, munber of play ers, and variety of research at the four mai Inrilities (last mainly Rochester and Pennstvania), as testilied to by the symposium organized by G. F. Herzog at the Baltimore AGU neeting on May 30 (Eos, May 3, 1983, pp. 282-284, and the meeting report in this issue of The VGP News). Papers involving AMS were presented on <sup>10</sup>Be in lake systems, <sup>10</sup>Be and Mal in ice, a beginning on ground water, 10Be in precipitation (2 papers), 10Be in sola and also in crossion and deposition, 10Be in phosphacites and in rende petroleum as well s in a manganese crust and, of course, tektites (2 papers). If I've examined correctly the symposium involved 3to researchers, some al whom are on more than one paper. The in-terest is certainly there and should boild duing the decade.

> Bruce R. Doe Editor, The VGP New

Article (cont. fcom p. 593)

rentric roadinates of earth-lixed points, establishment of ties between world datums and determination of polar motion and the earth's gravitational model.

The launching of the lirst satellite during the tGY and the subsequent launching of iledirated geodetic satellites started a new era of global "datums." DoD was first to solve such a datum in 1960. The solution that becone koown as the World Geoletic System (WGS) in 1960 thus provided for the first time a "truly" geocentric worldwide coordinate system for global mapping and charring.

### 5. Gravimetric Investigations

Under the IGY gravity program, DoD played (we important toles: first, to participate actively in gravity measurements all over the globe and, second, to provide logistic support to other agencies in remote areas like he Arctic and Antarctic.

The measurement program, besides lilling in the gaps where gravity observations were scarce and of doubtful accuracy, included the establishment of first-order stations, the calibration of gravimeters, the verification of the connections between estaldished stations, and the extension of the worldwide gravity net including ocean areas. In remote territories like Antaretica, gravity measurements were also made in conjunction with seismic and glacial studies to improve our knowledge of isostatic compensation in that area.

DoD was also one of the pioneers that recognized the importance of a "combined" solution from surface gravity information and observations of satelline orbit perturbations available from the IGY earth satellite programs. From the initial computation of the third zonal harmonics in early 1959, DoD was among the first to solve a glokal geopotential model under the World Geodetic System project the following year.

In its logistics support role, the U.S. Navy's ship The Composs Island provided a gyro-stahilized platform for the first successful sea surlace gravity observations on November 29, 1957. This historic operation thus established that it would be possible to acquire data from over 80% of the earth's surface in the succeeding years. Along similar lines, indispensable airborne and ground support were sup-plied to the IGY Amarctica gravity maverse teams by a U.S. Navy task force.

## 6. Geodetic Laser System

The pioneering efforts to develop satelline laser illuminating and ranging techniques were successfully conducted by AFGL in 1963. Also, experiments with corner-cube reflectors (CCR) by the Army Map Service (now

DMA) hegan in the years following the IGY. These are examples of DoD's indirect contribution to geodesy. It is interesting to note that earlier attempts with CCR's were performed with 60-inch searchlight beams. On the basis of the knowledge acquired as a result of the IGY, it is not a surprise that these attempts failed because of large amounts of backscatter.

As the system design progressed, the CCR's were replaced by more ellicient retrorefleciors. The original roncept to measure distances with geodetic accuracy became a realiy. We all know that in today's world lasers form the essential ingredient of some of the most accurate and complex geodetic instruments, and the word laser itself has become synonymous with high accuracy geodesy.

### 7. Summary

On this occasion marking the 25th anniversary of the IGY, this artirle has recalled some of the DoD activities of the initial years that significantly contributed to the IGY satellite programs involving active, passive, and coopcrative satellites.

Today, DoD continues to aupport the derelopment, enhancement, and application of new technology in such areas as satellite altimetry, airborne gravimetry, gravity gradiometry, inertial surveying, interferometry, charge coupled devices for geodetic astronomy, and others. And, of course, there is a tremendous effort going into the Global Posi-

tioning System, which is scheduled to be on erational later in this derade Time does not allow mention of all the

contributions made by DoD tomponents that fulfilled the IGY oldectives in smellite geode sy theory, practical methodology of data reclustion, satellite tracking techniques and instrumentation, gravinerric investigations, and other basic research. It suffires to say that much of today's technology is a result of the stimulus provided by the dedicated and concentrated efforts begun during the KY. It has been a lantastic 25 year era for geodes and for us.

Contributions require people, and whilek is not our intent to memion all of those assoriated with or supported by DoD during this era, the geodetic world will remain beholder to those represented by the likes of the fellowing: the O'Keeles, Kanlas, Chovitzes, Fischers, Lewiys, Anderles, Kershners, Weif-Tenleuchs Newtons Cabous Whimles Hedens, Markowitzes, Winklers, Heiskanens. Uotiks, Muellers, Rapps, Woollards, Talwantis, Williamses, Murrays, Eddhardts, Box gigeorges, Wirtanens, Fallers, Benders. homicsons, Szabos, Schmids, Mancinis, Gamleines, Martins, Deckers, Ballews, Daugh ertys, Wilcoxes, Ewings, Whites, Macombers,

Schwiderskis. Acknowledgments. Our appreciation is provided to Minneendra Kumar of die Defense Majeping Agency Hydrographic Topo-graphic Center, who assisted us with this ari-

Yews

A Land

\* **\*** 

...

# Antarctic Research **Priorities Set**

Highest priority for future research under the U.S. Antarctic Program should be given to the "extraction of the onique climatic record preserved in the Amarctic ire sheet" and to "the study of the response of maxine life to tic crustal structure and history and the the unique environment at the edge of sea ire." That's the word from the National Research Council's (NRC) Polar Research Board, which was asked by the National Sricure Foundation (NSF) to recommend priorlties for research efforts in the Antarrtic, NSF funds the U.S. Antaretic Program. The buard tromagnetic waves and energetic particles, order of priority, identified three smaller, more specific projects that should be included in the U.S. Antarctic Program, and listed other necessary, supportive activities with "wide-

spread implications and applications." The board says that the best long-term results will be gleaned from the U.S. Antarctic Program with a mixture of the "intensive, integrated, large-scale projects focused on one or more of the principal research questions," the "smaller-scale, lower-cust projects," and "other activities, including ongoing collection and analysis of data, publication of scientific results, and production of maps."

In addition to the two projects tagged as highest priority, the Polar Research Board recommended in its report, Research Emphase for the U.S. Antaretic Program, six other largescale, integrated projects. Very high princity. in the board's riew, should go to

 A major interdisciplinary study of the continental margin in the Ross Sea area of Antarctica, involving marine geology and geophysics, oceanography, and marine biolo-

 A program of suroral, magnetic, ionospheric, and thermospheric measurements from South Pole Station to develop an understanding of global energy transfer in the

nagnetospheric cusp and polar ensp.

• An interdisciplinary investigation of the structure and intensity of the Weddell gyre and the impact of the associated floxes on the rlimatic, glacial, and biological environment.

High priority was assigned to A coordinated program of geophysical studies aimed at understanding West Antarcdynamies of the ice sheet.

 A multidisciplinary study integrating physical and biological measures to determine causes lor, and ecological consequences of, the swarming behavior of krill.

A study of the interaction between elec-

In addition to those eight projects, the board recommended three small projects.

The first, designated as very high priority, is studying the life-history patterns and adaptathus of the Antarctic biota. The remaining two, assigned high priority, are measuring the heat budget at and around South Pole Station and studying the biogeochemical proresses in Antarctic ecosystems.

Other activities within the purriew of the U.S. Antarctic Program that the Polar Research Board sald should be continued include "the production of topographic and geologic maps; the collection of meteorites; and the monitoring programs at South Pole and McMurdo stations that provide data on upper atmosphoric, cosmic, and solar phe-nomena, earthquakes, and earth tides, constituents of the atmosphere, and standard meteorological data,"

To effectively implement the research projects identified, the NRC board said that "support systems permitting longer operating seasons and covering wider geographic areas"

Charles R. Bentley, at the University of Wisconsih's Geophysical and Polar Research

Center, is chairman of the Polnr Rescarch Board. Three ex officio members and four agency liaison representatives complement the 16 scientists who constitute the board. W. Timothy Hushen is executive secretary.

# Diamonds at High Pressure

New calculationa indicate that diamonds may not have any phase changes at pressures below 28 × 10<sup>11</sup> N m<sup>-2</sup> (23 Mbar) (M. T. Yin and M. I. Cohen, Physical Review Letters, 50, 2006, 1983). The in course affects the applications of diamonds beyond their value as gem stones. Single crystal diamonds have served as very strong windows for the transmission of a range of radiation spectra in high-pressure experiments, The ultimate strength of diamonds, however, chuld mark the limit of experiments at 1 Mbar and higher pressures.

A few laboratories have been able to experiment at pressures equivalent to those at the earth's mantle-core boundary (approximately 1.5 Mbar), but such experiments can hardly be considered routine. Extrapolations front experiments done by the General Elecinc Research Laboratory in Schenectady, N.Y., and by J. A. Van Vachten (Physica Status Solidi B. 47, 261, 1971) suggested that diamonds might undergo a phase change at about 1.8 Mbar; if so, diamonds used as window-annils would fail at the transition. There has been speculation that the phase change would include a reorder of dismond's elec-

tronic structure to the metallic atate. Yin and Cohen calculated that a high-prespseudopotential technique (hey employed has data). and is becoming a valuable tool in chystal cul- with a common field of view covering

culations. According to an account by J. Will al the Chrenden Laboratory, University of Oxford, "Yin and Collen assumed only the atomic number of the element and the type of crystal structure and then determined lattice constnuts, collesive energies and bulk moduli" (Nature, 305, 102, 1985).

The earlier work of Van Vechten had pointed toward a B-tin (tetragonal) crystal structure for the high-pressure carbon phase in analogy with silicon and germanium. Yin and Cohen obtained consistent results but a different result for the diamond. The 23 Mbar transition pressure bodes well for nisk ing experiments above the present 1.5-2 Mbar maximum. The new results say nothing, however, of the yield strength of diamond, which could result in flow or failure at considerably lower pressures .- PMB

# Real-Time Ionosphere Data

lonospheric electric fields estimated from observations with the STARE (Scandinavia) Twin Auroral Radar Experiment) system have been available in real time since August 1983. Such field information is very valuat To carry out well-defined experiments in the earth's ionosphere/magnetosphere system, it is desirable to kave access in real time to date which define the state of this system. On the principle that no geophysical event is unique conditions in the ionosphere/magnetosphere are recurrent, and thus the state photed by an experimenter will reoccur eventually to determine when, experimenters have usually relled on observations that yield information

Scardinavia, Simultaneous edeervations of diation. This sudden deposition of energy, arkstatter intensities and Doppler velocities from the two radars allow estimates of the monomies electric field with a spatial resolution of  $20 \times 20$  km and a temporal resolution dypically 20 s. The only requirement is that the electric fields exceed a threshold of along 15 mV m4 for generation of radar acroral irregularities (see E. Nielsen and J. D. White-head, Advances in Space Revened, 2, 131, 1983. and R. A. Creenwald et al., Radio Science, 13, The radar stations are computer controlled

sion would be tightly collinated in a tunnel called a Snort. The Snort is actually a flexi-Data General Nova 2, 16 kilobyte (nemory) and in continuous operation. Both stations like title that holds a series of superconductare now equipped with communication solting magnets. Even at a distance of 1000 km wate (written by C. Steward, Leicester Unithe low divergence of the neutrino beam renity, UK) and hardware, which permit would result in a radius of only 10 m. then to be reached over the normal telephone system. All parameters governing the trino-Induced Sound), is the application of radas operations as well as all measurements the Gentron to locate petroleum deposits at are transmitted at the end of each integration great ilistances. At 1000 km an array of geo ine. This transmission does not interfere phones with frequency ranges of 1-100 Hz with the normal operation of the radar. would be timed in on the acoustical beam All experimenters desiring access in real and at the same time filter background and

time to STARE data are invited to call one of boh of the radar stations and no use the transmitted data to help determine when an periment should be initiated. Should the STARE system be used later in the analysis and interpretation of observacious, then a cooperation with the STARE greaty should le arranged. We believe that this access could be of interest for granad-based experiments. sielite experiments (for example, HEAT-ING. EISCAT, VIKING), and rocket and balloon experimeous. Two rocket ranges IAN-DOYA and ESRANGE) lie within the STARE

For more information, routact E. Nielsco, Max-Planck-Institut fiftr Aeronomie, D-3411 Kalenburg-Lindan, FRG. The STARE system's operated by the Max-Planck-Institut for Aeronomie in exoperation with ELAB. University of Trondlicim, Norway, and the Funish Meteorological Institute, Helsinki,

## Prospecting With Neutrinos

One of the latest attempts to explore the inclue between physics and geophysics is the caravagant scheme of Alvaro De Rújula, Shelion Glashow, Robert Wilson, and Georges Charpak, to be pulldished in Physics Repet to what these theoretical and experimental physicists described recently as "our and project" (Physics Tuday, August 1983), a nergy neutrino beam is to be used as a gophysical prospecting tool.

The beam would be able to book for oil, natural gas, and high-stomic-number metal ors, and it would be alde to profile the vertieldensity distribution of the earth. De Ruwhen al. come to this project Iron the world of big physics machines, so it is natural to esreathat the "Geotton," the field instrument to supply and focus the neutrino beam, is to

To their credit, the four partirle physicists breworfed about the consequences and the osa. They think that the machine could be both for about \$1 billion, or even less; however,they concede their real concern is that it would be even more: "it inlight cost very such more if built under the losing supervison of present-day hurenverats. The contion could well be drawn out into a Jolesbrall Nirvana for years as the rosts double and then double again. This subering iditall for projects is not, experience informs us, the

What the neutrino beam really does is to provide a train of acoustical disturbances and madear particles along its path us it travels through the earth. The process functions as is one when a nucleus hits a nucleus it produces a forward moving shower of tharged partirles (which louize the medium)

naturally relate to rig design and safety measures but onshare facilities will also have to be designed accordingly" (New Scientist, Sept. g. 1983). Exploration and drilling techniques similar to those used in the North Sea, although to shallower depths, are being used. The politi-

# Nominations for Medals and Awards

ulstanding contributions to fundamental geophysics and for unselfish opperation in research.

Maurice Ewing Medal. Honors sn adividual who has led the way in individual who has led the way in understanding the physical, geophysical, and geological processes in the ocean; who is n leader in ocean signering, lechnology, and instrumentation; or who has a very differentiation; or who has a very differentiation. Robert E. Horton Medal. Given for outstanding contributions to the geophysical aspects of Hydrology.

hysical aspects of Hydrology James B. Macelwane Awards. Up to hree awards are given each year for

William Bowle Medal. Awarded for of outstanding ability. Recipients musualistanding contributions to fundational be less than 36 years old.

be less than 36 years old.

Letters of nomination outlining significant contributions and curriculum vitae should be been directly to the appropriate committee chairmen:

Howe in daily Eugene M. Shoemakar, the S. Seological Survay, 2255 Gemin Dive, Flagslaff, AZ 86001; Ewing Medal - Robert O. Reid, Department of Occasion replay. Texas A&M Uniof Oceanography, Texas A&M University, College Station, TX 77843 Horion Medal - R. Allan Freeze, Department of Geological Sciences, University of British Columbia, Vancouver, B.C., Canada V6T 1W5 Macelwane Award - J. Preeman Gilbert, IGPP A-025, University of California significant contributions to the geo.

Physical sciences by a young scientist.

San Diego, La Jolla, CA 92093.

Deadline for Nominations is November 1, 1983.

cal boundaries will not he so easily settled, however. The China Sea and its islands are a great potential source of political conflirt, the entire area being claimed by mainland China. the Philippines, Taiwan, Vietoam, and oth-

# **Society Merger** Rejected

and neutral particles; the neutrals (mainly pi-

ans) alecay to prochice additional ionizing ra-

produced in a narrow cone of ionization, pro-

The neutrinos, whose energies are mea-

sured in TeV, are produced by a Geotron,

which is an underwater-based synchrotron.

The Geotron would provide a proton beam

of 10-20 TeY that in turn would impinge

ilpui a target to yield a collinated beam of

pions and kaons that would undergo decay as

resons to neutrinos. This process of conver-

GENIUS (Geological Exploration by Neu-

seismic noise. Enormous areas can be sur-

veyed and at great depth [the signal energy

falls off with the first ranker than the Jourth

It also would be feasible, according to the

operated plan, to measure the innon beam.

bigical Exploration with Miions Indured by

Neutrino Interaction). Muon sensors could

through high-atomic-number metal concen-

cations is that it can penetrate the entire

earth. In the Geoscan mode a special, verni-rally oriented heam of neutrinos would be

aimed at the earth in such a way that it would

travel through the center of the earth, pene-

trating the core. Muon detectors would sain-

ple the beam at various angles. It should be

earth's radial density distribution to high ac-

The project is being proposed as a selling point for construction of the Texatron, the

luge hadron collider accelerator that has

been suggested for the Texas A&M campus.

The Texation could provide a neutrino beam

that would be used to test these ideas of geo-

China's Petroleum

Perhaps because of declining yields inlamb,

its spene-ridden coast to develop additional

ceruleum reserves. During 1979 and 1980,

in what has been termed the world's record

"seismic shoot" over 411,000 km² extending

from the Yellow Sea through the South Chi-

na Sea, and including Beibu Wan (Gulf of

are estimated to be 40-100 billion barrels.

The seas odl the mainland are relatively similor (most drilling has been done in less

than 110 m) but they are sturmy. According

to a recent description, "Typhoons can ...

occur in the area at almost any time of the

more) which they generate frequently wreak Itavoc in the Philippines, Vietnam, China,

and occasionally, Hong Kong. Typhoon Vera, which hit southern China in late July

did immense damage and flatmed dozens o

lives. The main Implications for oil operation

year, and the strong winds [160 km h-1 or

possible to oldain a determination of the

enracy in a short time.

physical exploration.--PMB

Reserves

A crurial property of the beam in all appli-

detect differences as the beam passed

power of depth, as with seismic waves).

nces an aconstical signal."

Members of the American Society of Photogrammetry (ASP) and members of the American Congress on Surveying and Mapping (ACSM) have rejected a plan to consoli-

An affirmative vote of at least two-thirds of each society's members present or represented by proxy was required for the merger. Voting in favor of the consolidation plan were 61.2% of ASP voters and 63.7% of ACSM voters. Almost 50% of eligible membees of each society participated in the September 21 vote.

The coosolidation had been discussed for several years and was formally proposed in June 1981. In September 1981 the two societagreed to affiliate | Eos, November 10, 1981, p. 765) and agreed to prepare a consolidaton plan. Although the consolidation was Thus GENIUS would become GEMINI (Georejected last month, the societies will retain their affiliation. As alliliated societies, they are located in the same building in Fulls Church, Va., and share a single governmental affairs program and an educational program.

## **IOI Seeks** Nominations

Joiot Oreanographic Institutions (JOI), Inc., is seeking nominations for a new panel to coordinate scientific ocean drilling. To be called the U.S. Science Advisory Committee (USSAC), the panel would complement the work of the John Oceanographic Institutions for Deep Earth Sampling (JOIDES). The Board of Governors of JOI says in

wants USSAC to include broad representation from academir, government, and indusmy sectors outside the 10 JOI member institations, and it is invaling naminations, including a brief vita and list of publications, for mendership on USSAC to be sent, by Novender 3, to John H. Clotworthy, JOI, Inc., 2100 Pennsylvania Ave., N.W., Suite 316. Washington, DC 20037.

# Geophysicists

the People's Republic of China has moved to Richard C. Hart is the new secretary of the U.S. National Committee for the Committee ld foreign oil-exploration companies engaged on Space Research (COSPAR). Han sucreeds Dean Kastel, who is now the executive secretary of the National Research Council's Space Science Board. In addition to his new duty with COSPAR, Hart serves as the staff officer Tonkin), the bay lying east of Hanoi and west of Hainan Island. These offshore oil reserves for the Spare Science Board committees on space astronomy and astrophysics, solar and space physics, and data management and

John H. McElroy was recently appointed assistant administrator for the National Environmental Satellite, Data, and Information Services of the National Oceanic and Aimospheric Administration, McElroy had been acting assistant administrator since February

Timothy D. Steele has accepted a position as water resources manager of the Denver office of In-Situ, Inc., a high-technology consulting company serving the mining and energy industries. Steele previously worked for more than 13 years with the U.S. Geological Survey's water resources division. Most recently, he was chief of the water quality group in the Denver office of Woodward-Clyde Consul-

# Recent Ph.D.'s

Ear periodically lists information on recently accepted doctoral dissertations in the disciplines of geophysics. Faculty members are invited to submit the following information, on institution leuerhead; above the signature of the faculty actisor or department chairman: the dissertation title, author's name, name of the degree-granting department and institution, and month and year degree was awarded. If possible include the current address and telephone number of the degree recipient (this information will not be published).

Methane and Radioartive Isotopes in Submarine Hydrothernmal Systems, Kyung-Ryul Kim, Scripps Institution of Oceanography, Univ. of California, San Diego, June 1983.

The Oceanographic and Geoidal Components of Sm Surface Topography, Victor Zlotnicki, Joint Program in Oceanographty and Oceanographic Engineering, WHOI/MIT. June 1983.

June 1983.
Vorticity and Upwilling Near an Isolated Feature
on the Continental Shelf, Stephen M. Chiswell, Marine Sciences Research Center, State Univ. of New York, Stony Brook, Au-

# Climatić Changes

by M.I. Budyko (1977) English translator, R. Zolina English translation editor, L. Levin

262 pp • extensive bibliography • \$24

This classic volums discusses the principal lasturas of modern climate and climatas of the pest.

Budyko discussea tha silacis of climatic changas on blological processes, including the evolution of living organisms and examinas apacilic sitersiions in micro as well aa macro climatic conditions. The author presents the need to dayalog mathods - and citers auggastions — to modify that sarth's climate. Climatic Changes is mus reading for all those interested in climsts

> 800-424-2488 462-6903 (locsl)

American Geophysical Union 2000 Florida Avenua, N.W. Washington, DC 20009

AGU mambais receiva 30% discount Orders under \$50 must be prapsid



Effects of Stze, Age and Photoperiod on Hypnosmoregulation in Brook Tout Salvelinus Frutioalis, Stephen D. McCormick, Joint Program in Oceanography and Oceanographic Engiocering, WHO/MIT, September

Foramiusferal Trace Elements: Uptohr, 19agement and 100 m.y. Poleochemical History. Margaret L. Delancy, Joint Program in Oceanography and Oceanographic Engineering. WHOI/MIT, September 1983.

Processing and Inversion of Arctic Ocean Refraction Data, Gregory L. Duckworth, Joint Progrant in Oreanography and Oceanographic Engineering, WHOI/MIT, September

Purification and Characterization of the Hepatic Microsomal Monooxygenetic System from the Constal Marine Fish Stenotomics Chrysopi, Man V. Klotz, Joint Program to Oceanography and Oceanographic Engineering, WHOI/ MIT. September 1983.

Wave-Induced Turbulerd Flow Near a Rough Bed: Implications of the Time-Varying Eddy Viscosity, John H. Trowbridge, Joint Progrant in Oceanography and Oceanographic Engineering, WHOI/MIT, September

Effects of Poce Pressure, Confining Pressure and Partial Saturation on Permeability of Sandstones, Joel Dan Walls, Dept. of Geophysics, School of Earth Sciences, Stanford Univ., January 1983.

Relative Motions Between Oceanic and Continental Plates in the Pacific Basin, David Cal Engebretson, Dept. of Geophysics, School of Earth Sciences, Stanford Univ., January

llow Boreholes, Daniel B. Moos, Dept. of Geophysics, School of Earth Sciences, Stanford Univ., January 1983. A Study of the Seismic Strutture of Upper Oceanit

Crust Using Wide-Angle Reflections, Kristin M. M. Roler, Joint Program in Oceanograplry and Oceanographic Engineering, WHOI/MIT, February 1983.

Spectral Reflectance of Neur-Earth Asteroids: Imtion, Lucy A. McFodden, Dept. of Geology and Geophysics, Hawail Institute of Geophysics, Univ. of Hawaii, May 1983. Dip-Moveout by Pourier Transform, Ira David Hale, Dept. of Geophysics, School of Earth Sciences, Stanford Univ., June 1985.

Plow and Shin Friction over Natural Rough Beds, Christopher Paola, Joint Program in Oceanography and Oceanographic Engi-neering, WHO!/MIT, June 1983. Migration of Reflection Seismic Data in Angle-Midpoint Coordinates, Richard Albert Otto-

lini, Dept. of Geophysirs, School of Earth Sciences, Stanford Univ., June 1983, New Techniques in the Analysis of Geophysical

Data Modelled as a Multichannel Autoregressive Random Process, P. A. Tyraskis, Laboratory hi Applied Geophysics, Dept. of Mining and Metallurgical Engineering, McGill

Univ., Montreal, Canada, June 1983, Spatial Coherency of Seismic Woveforms, Keith Metaoghlin, Dept. of Geology and Geo-physics, Univ. of Calillarnia, Berkeley, June

Wave Propagation in Porous Rock and Models for Crustol Structure, Terry Dean Jones, Dept. of Geophysics, School of Earth Sciences, Stanford Utilv., June 1983.

# **Books**

### An Introduction to Crystal Optics

P. Gay, Longman, New York, ix + 262 pp.,

Reviewed by Donald E. Sands

An Introduction to Crystal Optics is a repriot-ing in paperback of a book first published in 1966. The preface states that the only mudification made in this version is an updating of the bibliography; however, a comprehensively rerised edition is promised "before long."

The book is essentially a treatment of classical optical crystalingraphy, little touched by twentieth century science. The tone is descriptive and qualitative, equations are rare, and the physics tends to be superficial. If physics is unt its limite, descriptive clarity is. This little volume is reconnected for its well-written exposition of the study of crystals with the aid of the polarizing microscope. It will serve as an excellent introduction to microscopy or uptical unineralogy. It will also be useful to the advanced reader seeking elementary explanations of what other works treat in a nuire et utlite manuer.

The lirst live chapters discuss the properties of light and its transmition through crystals. The wave character of light is described by analogy to water waves. The Huygens' enustruction is applied to the analysis of ware nutiun through isotropic media. After introducing optical anisotyopy via the transmission of light through rakite, the Hoygens' construction is extended to uniaxial crystals. The indicatrix is presented as an aid to understanding the transmission of light through crystals of any symmetry. Absorption in anisorropic media, dispersion, and pleochraism are covered in a brief changer.

These presentations of the properties of light are followed by six chapters of a practi-cal nature, treating the production of polarized light, the polarizing nucroscope, microscopic methody of measuring isotropic refrac-

tive indices, interference effects in parallel light and in convergent light, and dispersion of the indicatrix. The final, and longest. chapter shows how to apply the principles of the preceding chapters to micruscupic observations. Relegated to appendices are the genmetric properties of the indicatrix, the analysis and superposition of waves, the minimum deviation and the critical angle methods of measuring refractive indices, and optical ac-

Exercises accompany most chapters. A few of these are simple numerical problems, for which answers are supplied at the end of the book, but many are laboratory exercises requiring the use of a polarizing nvicroscope.

Donald E. Sauds is with the University of Kentucky, Lexington, KY 40506-0032.

### Mount St. Helens **Eruptions of 1980:** Atmospheric Effects and Potential Impact

NASA SP-458, R. E. Newell and A. Deepak (Eds.), NASA Scientific Information Branch, Washington, D. C., 110 pp., 1982.

This clearly and uniformly arranged little book repurts the results of a NASA workshop held November 20-21, 1980, in Washington, D. C., on the atmuspheric effects of the 1980 Mount St. Helens eruptions.

It is divided into the following six chapters: (I) Volcanulogical Description of the May 18, 1980, Eruption of Mount St. Helens, (2) Transport and Dispersion, (3) Chemical and Physical Measurements of the Volcanic Cloud Made In Situ, (4) Remote Sensing of Mount St. Helena Effluent, (5) Chemistry of the Mnuitt St. Heleus Effluent, and 16) Influence

of Mount St. Helens and other Volcanoes on

Climate and Weather. Each chapter closes ith conclusions and references.

The single chapters give a brief and clear description of the knowledge of the volcanic eruption itself; the resultant loading of the stratosphere with ejecta; the to-be-expected chemical processes in the stratosphere caused by the cruptive material; the cruptive material's time behavior; and the transport and dif-

fusion processes. In addition, the book gives a detailed description of remote sensing of Mount St. Heleus effluent, including satellite-based mea-surements (SAGE, SAM II), lidar systems, and methods of radiation measurements. Lidar results from stations in Europe and Ja-pan are used in graphs, unfortunately without references.

A special chapter is devoted to the untential impact on weather and cliniate of the Mount St. Helens eruption (the strongest emption since Fuego in 1974). A possible stratospheric warming and cooling of the earth's surface is tentatively suggested. Most prominent in the recommendations of this chapter is the need for long-term measurements of the stratospheric background in order to acquire precise knowledge of the un-disturbed conditions prior to future cruptions. Such eruptions were not lung in coming: Alaid in 1981 and, in 1982, the massire eruption of El Chichon, whose terrestrial impacts can certainly no longer be neglected.

Mount St. Helens' eruption was thus an impressive reason for many researchers to prepare themselves for the eruptions of the recent past: That is the sense in which this book must be regarded as rely useful, although, considering the totally changed atmospheric conditions due to El Chichon's eruption, no longer quite up to date. The book's text and illustrations (30 of them, many in color) are well printed and it should be available in the

search on the global atmospheric process. Vet, at the end, a remark: Right before the workshop on the topics of the book under re-

riew, another NASA symposium was held November 18-19, 1980, also in Washington, D. C. The title was almost the same and the scientists in attendance were 3 times more numerous; the papers are printed in their entirety as NASA Conference Publication 2240. The volume has 303 pages, approximately 180 ligures, and very complete references k is only its part identical with the book under review and it, too, tleserves special attention.

R. Reiter is with the Fraunhofer-Institute for As muspheric Enryvanmental Research, D-8100 Gos misch-Partenkirchen, Federal Republic of Germs-

# New Publications

Items listed in New Publications can be ordered directly from the publisher, they are not available through AGU.

Statistics on Spheres, G. S. Watson, John Wiles, New Yurk, x + 238 pp., 1983, \$21.50. Stellar and Planetary Magnetism, vol. I, The Fluid Mechanics of Attrophysics and Geophysics, A. M. Soward (Ed.), Gordon and Breach, New York, xí + 375 pp., 1983, \$69.50. To Quench Our Thirst: The Present and Future

Stout of Freshwater Resources of the United States, D. A. Francko and R. C. Wetzel, Univ. of Michigan Press, Ann Athor, vill + 148 pp., 1983, \$8.50.

Underground Sound: Application of Seismie Waves, J. E. White, Elsevier, New York, wi + 254 pp., 1983, \$59.50.

Variations in the Global Water Budget, Sympo-sium out Variations in the Global Water Budget, Oxford, 1981, A. Street-Perrott. M. Beran, and R. Rateliffe (Eds.), D. Rei del, Bostou, xir + 548 pp., 1983. World Ocean Atlas: Arctic Ocean, Introduction

and Index, Pergamon, New York, xx + 41

libraries of all engaged or interested in re-

University of Florida. The Department of Deulong instead applications for a rection-stark position will beginning with the full terms, 1984. The presiston will be filled at the assistant of associate professor level. Bird at the assistant of associate professor level, a Fa.D. Is required and salary will be commensurable with qualifications. Although any rescarch squammarive lackground; and the capacity to develope will be considered, preference will be given to adjust the professor are assistant of a second program of the professor of the profe those with interest in these general areass, general model of the property of

Is 39811. The University of Flurida is an equal squad munits.

Fredig Poaldon in Geology/University of Puget Send. Tenure-track Assivant Produsent. Field-oriented Geomorphologiat with strong interest in Gatemary glacial analography and lands agree process to legin February 1. 1981 on September 1. 1984; alary commensurate with experience of the depointed 15 career faculty) has bong variablished, sacreful undergraduate program with point Land-pladen research. Team teach Physical Leology—Topic (all three faculty teach both lecture and lab) and each a senior level Leonau phodogy—Topic (all three faculty teach buth lecture and lab) with a process and quantitative foos, inducting computer applications (Fall). Teach Physical Geology tlecture and lab) and stare teaching responsibilities in Historical Geology (sping). Participate to departmental/University governance, advice students, and continue understoned declopment. Ph.D. in Geology, ability to teach both major and non-majors, and ability to carry out opposite, interdisciplinary research with endergodaute geology and other science majors. Additional info available at Indianapolis CSA meeting). Submi detailed via, statement of short- and langum career objectives, transcripts, and names of these references by November 10, 1983, not food283, Taoma, WA 98407.

An Equal Opportunity, Affirmative Action Educated Processing of the process of

Poddectoral Position. Available for the experimental ady of the entrainment, sleep sition, and transport of ediments in lakes and occurs. The research side primarily in the laboratory but will also invoke some field work. Competence in experimental fluid methodics and interest in encironmental products in accuracy. The position will remain open unal fluid. Applicants should send resource and traines of these feetness to:

of three references to: Professor Williem Lick Department of Mechanical & Environmental Engineering University of California Sente Barbara, UA 93106 An Equal Opportunity/Allicustory Action Em-

Peddetoral Awards in Ocean Science and Englowing. Woods Hole Oceanographic Institution in the applications for 1-year posterior at a solution seed from new and recent doctorates in India of

being demary, engineering, geologe, geophysics when are, engineering, geologe, geophysics when accordingly. Recipients of awards are selected engagedist lacis, with primary emphasis their means are selected.

ensempedive lusis, with primary emphrisas pavel or reserve promise.

Felositio them it \$22,1000. Appointees are eligible for group health invariance and a mordest research budge. Reclaients are encouraged in pursue this conversarch interests independently of in association with resident staff. Completed applications must be received by January 1, 1984 for 1984-85 mards Acards will be automitted by March 19. When for application furnist to: Para of Goodinal Sala, P.O. Box E. Woods Hall the rangempher Industrial Departments of Acards and Institution.

Ode State University/Selsmologist-lettanphysicist. The Hepartment of Geology and Mineralogy, The Olito State University, invite applications for a tenure-mark position for a gen-phant with recommendate. operations for a tenure-track yashirut lur it gen-phasis with recent hinterests in seismology and/ in econophysics. The successful appth and must be present to assist to teaching exploration grouply-arouses, advanced topics in his/her speciality, coder research, and supervise graduate students, before will be given to conditions with post-dots, and or industrial experience. Rank and sultry com-smante with experience and research record. Successful applications or numinations as sum as posible to:

Dr.Ralph R.H. von Frese
Lishman, Searth Committee
Department of Gerbogy and Mineralogy
The Olia State University
Columbus, OH 43210
Phone: (614) 422-(744) or 422-2721
spications should inclinic a resume, a statement stearch interests and the manes of at least three on whom we may contact for recommendations about the applications is December 1885, appointments will be effective no later October 1, 1984. Additional information can Daised by writing or calling the scarch committee.

The Ohio State University is no equal opportuni-

# **Earth Sciences**

of one year (extendable to two slipend of \$25,000 per ennum.

Completed applications are to be

Columbio Univarsity is on Affir-Employer!

in tururaligiaphy, micropaleontology and sedimen-nary perrology.

Ph.H. or equivalent is required by the time of sp-pointment. The successful applicant will be expect-ed to teach graduate and undergraduate courses sp-propriate to their expertise, conduct research and supervise graduate nuclents. Rank and solary com-mensurate with experience and research record.

Please send applications or nontinations as soon as possible in:

Hr. Walter C. Sweet Chairman, Search Committee Department of Geology and Mineralogy The Ohio State University Calambus, OH 48210 Phone: [614) 422-2326 or 422-8746 ultrations signal includes a reasonable Applications should include a resume, a statemental research record and interests and the mames of at least three persons whose we may rostact for reconstructions. The dosing state for applications is December 23, 1983; appointments will be effective no later than October 1, 1984. Additional information can be obtained by writing or calling the search committee chairman. The Ohio State University is an equal opponuni-

nice action employer.

Ohlo State University/Structural Geologist. The Hepartment of Geology and Alineralogy. The Ohio State University, incites applications for a tenture-track justified for a structural geologist with a strung background in quantitative analysis of field duta and research interests in regional tectonics or tectonophysics. The successful applicant will be expected to participate in the undergraduate program and give graduate courses in his/her field of expertise, conduct research, supervise graduate students, and interact with other departmental programs in regional geology and geophysics. Preference will be given to candidates will post-doctoral or industrial experience. Rank and salary commensurate with experience and tescarch retord. Please send appliexperience and research reford. Please send appli Carinns or non-finations as soon as possible to: Dr. Ralph R.B. von Frese

Chairman, Search Commince
Chairman, Search Commince
Department of Geology and Mineralogy
The Chair State University
Columbus, OH 45210
Phone: 1614-122-5635 or 422-2721
Applications should include a resume, a statement of persons and the trainer of at least three persons whom we may romact for recommendations. The closing date for applications is December 23, 1983; appendiments will be effective no later than October 1, 1984. Additional information can be obtained by writing at railing the scattle commit-

The Ohio State University is an equal opportuni iv/affirmative action employer.

The State University of New York at 84nghamion/ Petrologist. The State University of New York or cites applications for a removement faculty position in igneous on a termine-track factility position in igneous or metamorphic periology beginning Augusta, 1984. Appointment will be at the level of assistant professor. Candidates must have a Ph.B. degree by this date, and also the potential to develop a productive research program, as well as touch at the productive research program, as well as teach at the undergrammate and graduate levels.

Applicants should south a resume and names of at least three persons who can be contacted for references.

ences to:

Thomas W. Donnelly
Department of Geological Sciences
State University of New York
Ringhambur, New York 13901
The State University of New York at Bioghamb

Reflection Soismologiata or Ceologista. Bured by ull? IIIRPS—academit, selsnic profiling at sea to 15 security—seeks positions for geological interpretation and funuvative processing. Splendial environment. University salary. Send ev to 11r. Matthews, Earth Sciences, italiand Labs, Cambridge University.

Analstant/Assuciato Profossor (Ocean Engineering). Tennre-Track Preditan begianing 1981–1985 academic yem. Preference given to camildates with expertise in 1 or more of the fullowing areas: offstore and constal structures, necussic Imaging (including substation atmilles), oceanographic remote sensing, wave dynamics sediment transport. Must establish an active sponsored research program, teach graduate courses in area of specializadou and supervise graduate student research. Ph.D. or equivalent degree in specialty area required. Send resume, names and addresses of 3 references and a description of career goals by May 1, 1984 to: Dr. Malcoln L. Spalding, Chairman Search Committee, Department of Orean Engineering, UNIVERSITY OF RHODE ISLAND, Kingston, R.1. 02881–0814.

ent of Geosciences/University of House Department of Geosciences/University of Houston.
The Department of Geoscientes is interested in having applications for tenure track positions in the following areas: (1) Geophysics—seismology, exploration, data processing (2) Petrology—sandsiones and tenure track 193 Geochemistry—diagenesis and metamorphic [3] Geochemuty—diagenesis
Salary and rank commensurate with experience.
If loterested, please send:
||) A curriculum vitae
||2| A brief stalement of teaching and research in-

tion/equal-opports

Louislana State University/Tenure-Track Pacuity
Positiona in Geology. The Department of Geology is expanding from 15 to 36 facuity with four positions open Fall 1884 and one position (Field Camp Director) open January 1884. Candidates must have the Ph.D. and have active research in progress that might be applied to studies of basins. Specialides of primary lotterest-are field geology, theoretical selimotogy, hydrogeology, and organic geochemistry: however, other disciplines will also be considered with quality of retearch: being the primary factor in applicant selection. All facuity in the Department are required to conduct research leading to publicative required to conduct research leading to publicative and to provide quality instruction. The Department, will expand into n new building January 1986.

Por considers ton send resume, three letters of the position of research to Lyle.

1986.
Por consideration send resume, three letters of reference and a description of research to Lyle McGinnis, Pacitity Search, Department of Geology, Louisland State University, Baton Rouge, La 70803—4101. Search Will remain open until post-

Post-Doctoral Position in Isotopic Geochemistry-Department of Geology and Geophysics/University of Minnesota. Applications are invited for a post-doctoral appointment in geochemistry starting inu-ary 1, 1984. The candidate should have research interesu and training in igneous petrology and isoto-pic and trace element genchemistry. The appointed is expected to work on problems related to manule geochemistry and marrie general by available and geochemistry and magma genein, by application of sur-Nd and Rb-Sr intopir techniques and trace ele-ment geochemistry. Prior experience in sulid source mass spectrometry is desirable. The thiration of the initial appointment is for one year, with approprin-ties for renewal for a subsequent year or two. Statities for renewal for a subsequent year or two. Stating salary is in the range of \$17,000 to \$19,000, based on previous experience. Candidates should submit a resume with the names of three references well as being submit.

> V. Rama Muthy Dept. of Ceology and Geophysics University of Minnesota 310 Pillsbury Drive S.E. Minneapolis, MN 55455

The University of Minnesota it an equal opportu-nity educator and employer and specifically invites and enrourages applications from women and mi-

Cornell University Oppartment of Geological Selences. Applications are invited for a tenure-trark position at the assistant professor level to begin in Fall 1984. Specialties of interest are sellmentology, stratigraphy, and structural geology. Some experience beyond the Ph.O. is desirable. Send curriculum vitae and names of three references to Donald L. Turcone, Chairman Department of Geological Sriences Kimball Hall Cornell University

Cornell University Ithaca, New York 14858 Cornell University is an Equal Opportunity Em-

Physicist/Math Analyst. Sigma Data Services Corp., an M/A-COM Co., has an immediate opening for a Physicist/Math Analyst. Master's respectively. for a Physicist/Math Amalyst. Master's degree or equivalent experience in magneto-spheric physics or solar terrestrial physics is required. Experience with spacecraft or rorket trajectory calculations in desired. Must have working knowledge of FORTRAN and have at least three years experience in the use of computers for data reduction or mathematical analysis. Omies include enhancement in exiting programs, analysis, development, and implementation of new capabilities for determining multi-satellite, ground station, and magnetospheric model interactive data acquisition and analysis. Send resume to Dr. H. K. Hilli, Sigma Data Services Corp., NASA/GSFC, Code 1011, Greenbelt, Mil. 20171 or rall (201) 344-8105.

University of Alaska/Exploration Geophysicist—Seismie Stratigrapher. Applications are invited for a tenure-tract teaching research position in the Geology/Geophysics Program of the College of Encironmental Sciences. Prime responsibilities will be to teach graduate and some undergraduate our sex in the use of state-of-the-art techniques in permicini exploration geophysis. The successful applicant will also develop are innovative research program to romplement our growing pertulenting geophysicistical industrial experience in hydrocarbon exploration and, in particular, the use of seismic reflection data to incerpret stratigraphe and faries is desirable. The nine-mooth laculty position is open starting in January, 1984. stratigraphe and faries is desirable. The nine-mooth faculty position is open starting in January 1984. Rank and salary continensurate with qualifications and experience. Resinne and at least three references should be submitted to Dr. Juan G. Roederer, Director, Division of Geoscientes, University of Alaska, Fairhanks, Alaska 19701. Applications will be arcepted until Occember 15, 1985 or until position is filled.

Your application for employment with the University of Alaska may be subject to Public Divisoure if you are selected as a finalist.

The University of Alaska in an EO/AA employer and edurational insitution.

lowa State University of Science and Technology, Department of Earth Sciences. Applications are invited for a tenure teack faculty position in Meteorology. Rank is at the assistant or associate professor level, dependent upon qualifications. The successful applicant will be expected to develop a strong research and graduate student program and will teach undergratuate and graduate rourses for meteorology majors.

The position is for a person with proven expertise within the general area of dynamic meteorology. Teaching will involve an undergraduate course in synoptic meteorology, in addition to courses related to the field of expertise. Completion of the Ph.D. prior to appointment is strongly preferred. In addition, research ability shown by other publications and/or postdoctoral experience will be an advan-

lage.

Towa State offers degrees in meteorology through the Ph.D. The program includes about 60 undergraduate majors; the graduate/research program is strong and emphasizes theoretical, dynamic studies. Close relationships are established with the facilities and personnel of major national laboratories. New campus facilities for meteorology are currently underconstruction.

and personnet of major hadona abortact maps facilides for meteorology are currently under construction.

The appointment is expected to begin no later than September, 1984; an appointment during the current academic year may be possible. Application deadline is November 1, 1985; later applications will be accepted if the position is not filled. For application information please write to:

Dr. 8ert E. Nordlie

Department of Earth Sciences
lowa State University

253 Science 1

Ames, lowa 50011.

lowa State University is an equal opportunity/affirmative action employer.

NASA NSSDC/ACQUISITION SCIENTISTS

Sigmn Data Services Carp. a M/A-COM Company as contractor operating the National Space Science Data Center (NSSDC) at NASA/GSFC, has immediate openings for scientists in the following disdpilines:

—Astronomy/Solar Astronomy/Astrophysics (ca-pedally X-13 y) —Semote sensing/Meteorology/Almospheric Sciences —Lunar/Planetary Geology/Planetology —Magnetospheric Physics

M.S. iequired, Ph.D. preferred. Candidates should have experience in analysis of data from apacecraft experiments in their subject area. Working knowledge of FORTRAN is required, incumbents will serve as acquisition agents for data arcilived at NS3DC, interface with investigators, and engage in data synthesis efforts, and the generation of data catalogs. Research opportunities available. Send resumes to Dr. H. K. Hills, Sigma Data Services Corp. NASA/GSFC Code 601; Greenbelt, Md. 20771 or call (301) 344-8105.

# RESEARCH **OPPORTUNITIES**

swards for one or Iwo years' lenure in selected federal lebore tories throughout the United States. Opportunities ere evelleble for specialized experimental or theoreticel research experience—free of Interruptions end disfrections of other dulies—in the general

ATMOSPHERIC AND EARTH SCIENCES • ENGINEERING LIFE AND MEDICAL SCIENCES PHYSICS • CHEMISTRY ENVIRONMENTAL SCIENCES MATHEMATICS • SPACE

senior investigatora as well ee to recent PhDs.

Aesocisteship Programs (JH 608-U2) NATIONAL RESEARCH COUNCIL Washington, D.C. 20418



The University of Missouri-Columbia/Faculty Posi-tions. The University of Missouri-Columbia De-partment of Geology plans immediate expansion through the addition of three tenure-track faculty

Exploration Geophysics Solid-Earth Geophysics Hydrogeology Analyscal Structural Geology Clastic Sedimentology Applications should send resume, transcript, and names and addresses of three references to:

Tom Freeman, Chairman

Trent University/Environmental and Resource Studies Program. The Trent Aquatic Research Croup lovites applications for a Research Associate with interest in movement of radioactive isotopes through aquatic ecosystems. Previous experience in lab and field research in low level isotope measurement or chemical speciation is required. Applicants should possess a Ph.D. in Applied Limnology, Chemical Engineering or equivalent. The position will commence on November 1, 1983. Send a letter of application with C.V. and copies of published papers to: Dr. R. D. Evans, Environmental Center, Trent University, Peterborough, Ontario, Canada.

Chairperson, Department of Geoseiences/Texas Tech University. Applications and nominations are sought for the above position. Requirements are n doctoral degree in a suitable specialization within the geosciences, or equivalent experience, and a record that would warrant faculty appointment at the level of Associate Professor in Professor. Desired qualifications are an established record of scientific contributions including a productive current research program, experience in graduate teaching and in supervision of M.S. and Ph.D. atudents, proven ability to obtain external funding, and indication of strong administrative ability.

mining, and statements strong administrate publicy.

Texas Tech University is located in Luisbock, un urban community with a population of uver 180,000. The University presently enrolls mure than 25,000 students. The Department of Geosciences offers courses in almospheric science, geochendstry, geology and geophysics. Degree programs lactude the B.A., B.S., M.S. and Ph.D. in geuscience, and M.S. in atmospheric science. The Department presently consists of approximately 250 undergraduate majors, and 16 facuity.

The position will be available August 1, 1984.

The nea of specialization is open, faculty rank and salary will be rommonsurate with qualifications. Applications and nominations should be sent to:

# Classified

RATES PER LINE

23.5

Positions Wanted: hirst insertion \$1.75, addition-Positions Available, Services, Sappiles, Courses, ond Announcements: first insertion \$3.50, ad-

ditional insertions \$2.75. Student Deportunitien: first insention free, addi-There are no discounts or commissions on classified ads. Any type tryle that is not publish-

er's choice is charged for at general advertising rates. For it published weekly on Tuesday, Ads must be received in writing on Monday, I week prior to the date of publication. Replies to ads with how numbers should be

addressed to Box ..... American Geophysical

Union, 2000 Florida Asenny, N.W., Washingon. D. C. 20009. For further information, call toll free 800-424-2488 ur. in the Washington, H. C., area,

POSITIONS AVAILABLE

North Carolion State University/Marine Chemist. The Department of Marine, Earth, and Anno-spheric Sciences invites applications for a 9 month, tenure track position at the assistant or associate tenure track position at the assistant or associate professor level. The candidate must have a Ph.D. and will be expected to interact with various research pringrams within the department such as: radiochemistry, stable isotope and trace metal geochemistry, sedimentology, trean circulation, air-sea interaction, and biological occanography. Responsibilities include conducting a viable research program as well as teaching and advising graduate sundents. Applicants should forward a resume and the names of at least three references to: Dr. David J. DeMaster, Chairman, Search Committee, P.O. Box. 5068, North Carolina State University, Raleigh, NC. 27650. Application material should be sent by No. 27650. Application material should be sent by November 30, 1983.

North Carolina State University is an equal op-

Florida International University/Faculty Position in Geology. The Licology program at Florida International University is expanding and plant to increase its faculty in the next few years. In order in complement exitting instructional and research strength, the University invites applications first tenner trock positions at the Assinant Professor level in the following areas of agest altration:

1. Ingueurs Petrology/Geothemistry/Eomomic

1. Ingricus Petrology/Geothemistry/Eomonic Geology
2. Geophysics/Marine Ticology
3. Stratigraphy/Sedhucutology
Successful applicants must have ifenumetrated an ability for high quality teaching and the potential in citablish a productive research program in the area of specially. Subject to final approval of funding, appointoceus will begin in August 1984. Deadline application is February 2, 1984. Send a restuce, brief description of teaching experience and research interest, transcripts, and three letters of reference to:

Dr. L. Keller, Chairman Department of Physical Sciences Florida International University Tamlami Trail Mami, FL 33(99

Florida International University is an affirmative ac-

National Genter for Atmospheric Research/Visitor Applicants. At the High Mininde Observators, Vintor Appointments are available for new and established 19h.D.'s for up to one year periods to carry out research in solar physics, solar-terrestrial physics, and related subjerts. Applicants shundly provide a curriculum vitae including education, work expenence, publications, the names of three scientists familiar with their work, and u statement of their research plans. Applications must be received by January 15, 1984, and they should be sent to: HAO Visitor Committee, High Allude Observatory, National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80507.

NCAR is an Equal Opportunity/Affirmative Action Employer.

Assistant or Associate Professor/The Chesapeake Biologieni Laboratory (CBL) of UMCEES. Applications inviteds for a tenure-track faculty position in manite or estuarine chemistry ar geochemistry. The successful caudidate will develop a program of research in their own field of interest; will play an important role in a growing program of chemistry and geochemistry at CBL, and will participate in interdisciplinary research programs with other scientlyts with specialties in chemistry, sedimentology, and physical and biological oceanography. Some preferent will be given to candidates with interests in trace or major element geochemistry or organic

trace or major element geochemistry or organic geochemistry, panicularly in relation to sediments. However, all candidates with interests in the broad However, all candidates with interests in the broad subject areas are encouraged to apply.

Applicants should have a mong post-doctoral research record, demonstrated interests in interdisciplinary research, and an interest in teaching and graduate research. Curriculum vitae, description of research interests and in tist of three to five references should be sent to: Dr. Jay C. Aletins, Chairman—Search Committee, UNICEES, Chesapeake Biological Laboratory, Box 38, Solonions, Maryland 20688–0038, Applications received by October \$1, 1983 will be assured full consideration.

The University of Maryland is an Affirmative Aution/Equal Opportunity Employer.

Atmospheric Dynamics and Planetary Physics/The Johns Hopkins University. The Department of Earth and Planetary Scientes intends to make a tenure-track faculty appointment in each of these arcas, one in July 1984 and the other in July 1986. The Atmospheric Dynamics just will be at the Assistant Prutessor level; applicants shoold have a demonstrated capacity for innovative research with, preferably, post-dortoral experience. The appointment in Planetary Physics will be made at a level rommensurate with the attainments of the successful candidate; for appointment as full professor, a high international rejuntation for research accompishments is expected. Women and minority condidates are especially entouraged to apply.

It is expected that the appointees will develop programs in teaching and research that will complement the activities of the present groups in geophysical fluid dynamics and geophysics, whose research interests include turbulence, wares, air-sea interactions, stratified flow dynamics, convection, mesoscale meteorology, dynamics of the earth's Interior, and volcanology. The appointee in planetary physics will be encouraged to interact strongly with scientista at the Space Telescope Science institute, which is on esmpis. The University b a member of the University Corporation for Atmospheric Research.

the University Corporation for Atmospheric Research.

Applications should include a critriculum vitae, copies of one or two recent publications and the names of at least three refereet. They should be sent by Joinary 18, 1984 to Professor O.M. Phillips, Chairman, Search Committee Department of Earth and Plauciary Sciences, The Johns Hopkins University, Baltimore, Maryland 21218.

The Johns Hopkins University is an Equal Opportunity Employer.

Meteocologist/The City Colfege of The City University of New York. The Department of Earth and Planetary Sciences invites applications for an anticipated opening in meteorology. The appointment will stan September, 1984, Applicants should have completed the Pl.D. by the time of appointment and have a strong background in synoptic ineteorology and computer applications. In addition, the individual should have an interest in annospheric chemistry or pollution as applied to urban areas, or physical occatography. The person hired will be required to teach rourses in meteorology, and possibly physical occatography as well as develop and maintain an active research program. Participation in the C.U.N.Y. Ph.D. Program it Earth and Environmental Sciences is unicipated. Rank and salary will be commensurate with experience. Send resume. Transcripts and three letters of reference by Notember SO, 1983 to Professor Dennis Weiss, Chairman, Oepartment of Earth and Planetary Sciences, the City College, 138 Street and Convent Avenue, New York, N.Y. 10081.

New York, N.Y. 10081.
The City College of the City University of New York is an equal oppurtunity affirmative action em-

Research Associate Position in Cratering Mechanics/Uolversity of Arlzona. A position is open for a young scientist interested in applying physical principles to the mechanics of impact cratering and studying the origin of meteorites, the morphology of large craters or the climatic effects of a large terrestrial impact. The applicant should have n Ph.D. in geophysics or a related field. Experienre with large numerical codes is desirable. A resume and three letters of reference should be sent to: H. J. Melosh, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721. All applications must be received by Nov. 1, 1983.

The University of Arizona is an equal opportunity employer.

Louisinna State University/Chea. T. McCoed, Jr. Endowed Professorship in Hydrocarbon Explora-tion The Geology Department is seeking au internationally recognized leader in some research specialty critical to the search for oil and gas to fill the Chas. T. McCord, Jr. Endowed Professorship. Applicants are expected to maintain scholarly research in their area of specialty. Rank at Full Professor level with salary competitive with endowed professorships at other major research universities. For consideration send resume, three letters of reference, and a description of future research programs to Lyle McCinnis, Faculty Search, Department of Ceology, Louisiana State University, Baton Rouge, LA 70803—4101. Search will remain open until posidon is filled.

LOUISIANA STATE UNIVERSITY IS AN AF-FIRALATIVE ACTION/EQUAL OPPORTUNITY

Washington University, 8t. Louis. Washington University, St. Louis, announces tenure track positions for the fall of 1984. Preference is for candidates in Geophysics, Structural Geology, Metamorphic Petrology, or Petrology of Extraterrestrial Materials. rials.
The auccessful candidate must have the following The auccessful candidate must have the following attributes: demonstrated creativity and prombe of excellence in research and teaching; intent to develop a vigorous graduate research programs dealer to teach courses in field of interest and related fields of geosciente at undergraduate and graduate kivels. Send resume, statement of future research interests, ond names of nt least three references to Larry A. Haskin, Chairman, Department of Earth and Planetary Sciences, Washington University, St. Louis, Missouri 63130, Applications received through January 1, 1984.

Washington University is no excellent to describe the control of the control of

Washington University is an equal opportunity/af-firmalive action employer.

North Dakota State Water Commission/ Ceoloydrologist. To work in aquifer evaluated and management. Bachelur's degree with two year experience or masters degree with experience in quantitative techniques required. Backgoond in watershed modeling, soil physics or onsomated flow processes thesical. Salary range \$1555.5223 up model. Salary per momb. Send resume to:

North Hakona State Water Commission Hydrology Dicision
Hust East Rouleward
Hismary k, North Dakota 58505
Nurth Hakura State Water Commission in an equal uppromuity/allicumive action employer

The University of New Moxico/Research Asso-clate. Applications are invited for a permanent position as a research associate in the Department of Geodogy at The University of New Mexico. The applicant illumbil have experience on characterizing the structure, may photogy and chemistry of solid materials with the analytical electron mitroscopt to be purchased this yeard and will be responsible for the day-tu-day uperation of the Instrument. The work will involve the characterization of netalice-trums and compusite materials, including reak-forming universits. The scanding transmission elec-tron microscopic will be part of an Electron Micro-leum Analysis Facility which includes a fully-automaned ARL EMX-SM electron microprobe; an

theam Analysis Facility which includes a fully-mummed ARL FMIX-SM electron microprobe; an mummed, live spectroneter, 753 JEOL. Superprobe and an Hiachi 450 scanning electron microst ope. Each insumment has an EDS and is housed in newly constructed inhoratories. Experience in x-ray diffraction crystallography and secondary x-ray linorescence analysis would be useful. The successful applicant is expected to maintain his/her own active research program and to intenst with faculy throog hout the University in cooperative materials science research.

A Ph.D. is required and the salary in in the range of \$27,000 to \$55,000/12 months commensurate with experience. Applicants should forward a desired resume to R. G. Ewing, Department of Geolesied resume to R. G. Ewing, Department of Geolesied Review 87151. Deadline for application is December 18, 1983.

ber 15, 1983. The University of New Mexico is an Equal Oppor-

To Do Today Call AGU at 800-424-2488. • Order books/journals Request membership. spplications: Register for meeting

· Place advertisement in Eos • Change address

The Lamont-Doherty Geological Observetory of Columbia Universily invites ecientists interested in any field of the earth sciences to apply for the following fellow-ships: Two postdoctorel fellowships, each awarded for e period years in special instances) beginning in September, 1984 with o

returned by January 15, 1984. Application forms mey be obtained by writing to the Director, Lemont-Doherty Geological Obser-Valory, Palisades, New York 10964. Award ennouncements will be made February 28, 1984, or shortly thereefter.

andlive Action/Equal Opportunity

599

terests
15) Three letters of recommendation to:
Dr. John C. Builer
Department of Geosciences
University of Houston
Houston, Texas 77004

tions are filled.

LOUISIANA STATE UNIVERSITY IS AN AFLOUISIANA STATE UNIVERSITY IS AN AFPIRMATIVE ACTION/EQUAL OPPORTUNITY

Competitive visiting scholer

fields of:

Most of the 19 progrems ere open to U.S. and non-U.S. netionals. and most ere open to experience

Application meterisis with detalls on research opportunities and Isborstory locations may be requested by letter, stating the speclic area of research interest. to:

2101 Constitution Avenue

NIOSH NBS NASA

Clearperson Scarch Committee
Department of Geosciences
Texos Tech University
P.O. Box 4109
Lubbock, Texas 79409

Letters of application should include via attel names and addresses of 5 references. The closing date for applications is January 20, 1984.

Texas Tech University is no equal employment opportunity and affirmative action employer.

Geophysicisi Tenure-Track Appolaimen/Department of Geology, University of Toledo. The position is effective September 1, 1981. Individuals with strong backgrounds in explotation geophysix—applied geophysics are of primary interest although other specializations will be misintered. The Ph.D. is required as well as a strong commitment to effective ceaching and research. The department has modern facilities and offers B.S., B.A., and M.S. degrees to approximately 60 madergraduate and 50 graduate sudents. The faculty consists of eight full time and live adjunct professors actively involved in a wide range of research purmits. Interested persons should submit a letter of application, resume, transcripts, and three letters of recommendation to: Sinatt L. Dean, Ehairman of Search Lonnninee, Department of Fiedogy, University of Toledo, Toledo, Obiu 43606, phone (-19) 537-2246 or (-19) 527-2009.

University of Talerio is an equal apportunity/af-

Professor of Marine Geophysica Tectonics/Sisn-ford University. The Department of Geophysics is seeking candidates for a fenure track position in the broad area of marine geophysics and rectunics. We seek a creative scientia with experience in gall-ering, interpreting, and synthesizing marine geo-physical data and whose research interests cover de-positional ignorus and to such assessment on conphysical data and whose research interests cover de-positional, igneous, and tectoric processes on occau-ic plates and continemal magins. Inquiries are invited from matine geophysiciss with demonstrat-ed scientific record in one of the above aspects of marine geophysics or tectorics, who have demon-tional an ability to develop the widers and research directions, and to guide and teach graduate and un-ilergraduate students. In considering this appoint-ment we are interested in maximizing interactions with surgoing research groups in number geology, plate tectorics, paleomagnetism, teismulogy and te-gional geology at Stanford. On new faculty mem-ber will be expected to develop a strong research program involving both government and industrial participation.

Salary and rank will be commensurate with experience and background. Please submit a resume, a brief description of teaching and research interests, and references to:

Dr. Amos Nu

Stanford University
Stanford University
Stanford, UA 91305
Stanford University is an equal apportunity employer, and encourages the application of qualitied women and minocities.

POSITIONS WANTED

Physical Chemistry. Ph.D. specialized in Isotopic Geochemical Basic Research would consider chal-lenging opportunity. P.O. Box 018 American Geo-physical Union, 2000 Florida Avenue, N.W., Waste-ington, DC 20009.

GRADUATE STUDENT NASA TRAINEESHIPS NASA TRAINESHIPS

The Florida State University is accepting applications from prospective gradiente stodents for participation in its NASA spouroned Trainceship Program Occamparathic Remote Sensing Techniques and Physics of Air-Sea interaction. The stipend for the calendar year is \$10,000. Students may be emoled for a degree in either occamparaphy or meteorology. For forther information or application, please write:

Dr. James J. O'Brien. NASA Traineeshin Program Meteorology Annex The Florida State University Tallahassee, Florida 32306 [904] 644-4581

# <u>Meetinas</u>

### **Announcements**

#### **River Basins**

The International Water Resources Association (IWRA) will hold a seminar at Linköping University in Sweden June 4-8, 1984, to discuss the relevance of the river basin approach to land and water management. The sentinar will try to reach conclusions about plans for fature actions using the river basin as the basic unit, specifically with regard to the criteria for environmental planning, for conflict resolution, and for developing coordinated land and water control.

Papers will deal with eight selected river basins and with four issues: river basins as ecosystems; legal and administrative issues; the problems of growing arkan systems; and

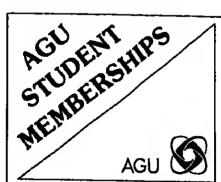
the problems of coordinating control and management of land and water resources. Those interested in attending should contact Uhik Lohm, Water Theme, Linköping University, S-58183, Linköping, Sweden.

### Offshore Minerals

A symposium to discuss plans for assessing and developing mineral resources in the re-cently proclaimed Exclusive Economic Zone off the coast of the United States will be held November 15-17 at the U.S. Geological Survey (USGS) National Center in Reston, Va. The symposium is being sunnsored by the USGS, the Minerals Management Service, and the Bureau of Mines to aid in organizing a coordinated government, university, and in illistry effort to evaluate the potential mineral resources in the new zone; the zone was proclaimed on March 11t, 1983, to extend U.S. mineral rights 200 miles offshore.

Presentations on current federal marine mineral resource activities will be followed by panel discussions on the science of resource assessment, the engineering technology involved, and the legal ramifications in developing these offshore minerals. The Secretary of the Interior is scheduled to be the keynote speaker; others from the White House, Congress, Department of Commerce, Navy, industry, and academia also will speak.

For additinnal information, contact the Assistant Secretary, Energy and Minerals, Department of the Interior, Washington, DC 20240 (telephone: 202-343-5691).



Available to students enrolled in at least a half-time study program leading to a degree in any of the geophysical

■Only \$7.00.

■Special low rates on AGU primary

Reduced meeting registration fees.

EOS is included frea with member-

■30% discount on AGU books. Full membership privileges including the right to vote and hold office.

Call toll free and ask for an application for yourself, your coleague, or your student(a).

800-424-2488 462-6903 In the Washington, D.C. area.

# **AGU Fall Meeting:** Travel, Housing, Registration

The 1983 Fall Meeting of the American Geophysical Union will be held in San Francisco, Calif., December 5-9, at the Cathedral Hill Hotel and the Holiday Inn Golden Gateway Hotel. San Francisco is a dynamic, exciting city, known to the world for its speciacular sceisery, fabulous resiaurants, cosmopolitan life style, and gentle climate. It is a superb meeting location at any time of the

#### Registration

Everynne who attends the meeting must register. Preregistration (received by November 10) saves you time and mnney. The fee will be refunded to you if AGU receives written untice of cancelation by November 28. Registration rates are as follows:

NAME ON BADGE

MAILING ADDRESS \_\_\_\_

**AFFILIATION** 

TELEPHONE #

Days you plan to attend

Piense check appropriate box

ntember rates

Please check the oppropriate box(es)

☐ Member AGU ☐ Nonmember

Member cooperating society:

☐ EGU-European Geophysical Union

☐ AMS-American Meteorological Society

ASP-American Society of Photogrammetry

□ Dec. 6

☐ Dec. 9

Members of the cooperating societies may register at AGU

ACSM-American Congress on Surveying and Mapping

HOTEL

Dec. g

RETURN THIS FORM WITH

PAYMENT TO:

Meeting Registration

American Geophysical Union

2000 Fiorida Avenue, N.W.

Washington, DC 20009

PLEASE PRINT CLEARLY

Preregis-After Member \$65 \$47 Student member \$32 Retired senior member \$47 \$32 (65 or over) \$105 Student nonmember \$41.50 \$56.50

### Registration for I day only is available at one half the above rates, either in advance or

at the meeting. Members of the American Congress on Surveying and Mapping, the American Meteorological Society, the American Society of Photogrammetry, the Europe-an Geophysical Union, and the Union Gentlsica Mexicana, may register at the AGU member rates.

If you register as a nonmember for more than I day, the first-year does for joining AGU will be waived if a completed application is received at ACU by Feb. 10, 1984. To preregister, lill out the registration

form, and return it with your payment to AGU by November 10. Your receipt will be included with your preregistration material a the meeting. Preregistrams should pick up their registration material at the registration desk at the Cathedral Hill Hotel. Hours are 8 A.M. 10 4 P.M., Monday through Friday 00 Sunday, December 4, registration hours are 5:30 to 7:30 P.M.

#### Hotel Accommodations

Blocks of rooms (\$47 singles, \$53 doubles are being held at the Cathedral Hill, the Holiday Inn Gulden Gateway, the Holiday Inn Civic Center, the San Franciscan, and the Grosvenor Inn for those attending. Read the housing application, and mad the completed application form to the boosing bureau each to ensure reservations at your preferred by tel. Reservation forms must be sent directly to the Honsing Coordinator, AGU Foll Meeting, San Francisco Honsing Burcou, P.O. Box 5612, Snn Francisco, CA 94101. Do not send housing reservation forms to the holels. Reservations must be received by Novem-

#### **AGU 1983 FALL MEETING DECEMBER 5-9** San Francisco, California

REGISTRATION FORM

Deadline for Receipt of Preregistration

MEMBER STUDENT MEMHER	More than one day \$65	One day \$32.50
RETIRED SENIOR MEMBER* NONMEMBER STUDENT NONMEMBER *65 nr over	☐ \$32 ☐ \$90 ☐ \$41.50	\$16 \$45 \$20.75
SECTION LUNCHE	ONS/DIN	INER

Peirology, Tucsday, \$9

Wednesday, \$5 - Hydrology, Wednesday, \$9

Solar-Planetary Relationships, Wednesday,

- Almospheric Sciences, Thursday, \$9 \_\_\_\_ Oeodesy, Thursday, \$9

Office Use

Total Enclosed \$ \_\_ (All orders must be accompanied by payment or credit

care information. Make eneck payable to Av	10.7
American Express Charge Io: Visa	
Charge to: Visa	
☐ Master Card	

UGM-Union Geofisica Mexicana If you register as a nonmember for more than 1 day, the first-year dues for joining AGU will be waived if a completed application is received at AGU by Feb. 10, 1984.

☐ Dec. 7

Preregistrants

Nonmembers

Your receipt will be in your preregistration packet. The registration fee will be refunded if written notice of cancelation is received in the AGU office by November 28. The program and meeting abstracts will appear in the November 8 Issue of Eos.

NOVEMBER 10, 1983 opplicable only if received by November III with payment)

Circle section and Indicate number of tickets. Ail lunches

begin at nonn. SPR dinner begins at 6:30 P.M. Planelology/Volcanology, Geochemistry and

Seismology/Tectonophysies, Tuesday, \$5 Ocomagnetism and Palenmagnetism,

Ocean Sciences, Wednesday, \$9

A DOUBERLE	Aake check	payable io	Auo.	•
🛄 Ame	rican Expr	ess		
o: 🔲 Visa		ess		¥.
☐ Mas	er Card			
				٠.

Masier Card Interbank No. Expiration Date

Mail your completed form directly to:

made directly to the hotel...

Housing Coordinator AGU Fail Meeting San Francisco Housing Bureau P.O. Box 5612 : San Francisco, CA 94101'

## FIELD TRIP FORM

I wish to attend the Franciscun Numi-terrane field trip on Sunday, December 4. My check for \$25 is enclosed.

In case I am not among the first 40:

[1] wish to be put on the waiting list. (If you don't go, money will be returned on the day of the trip.)

[] I wish my money returned.

FALL MEE

The City

by the Bay

ancisco Dec.5.9

HOTEL ACCOMMODATIONS

PARTICIPATING HOTELS

Calliedral Hill Holel

1800) 227-4730

(415) 441-4000

Grosvenor Init

(415) 673-7411

50 8th Street

(415) 626-6103

Van Ness and Geary

Hollday Inn Civic Cenler

San Franciscan Holel

ROOM RATES FOR ALL HOTELS

PARKING: Calhedral Hill Holel: free to registered guest

Il hotel reservations must be made on the housing form by November 1, 1983. No telephone requests will be

egistrants by the individual hotels. After confirmation

as been received, changes and cancelations should be

ecepted Confirmations will be mailed directly to

Hollday Inn Golden Galeway: free 10

San Franciscan Holel: free to registered

Suites available upon request

registered guest

1231 Market Street

1415) 626-8000

Single \$47

Double \$53 Twin \$53

Van Ness at Geary Street

1500 Vun Ness Avenue

Holldny Inn Golden Galeway

(1)

Mail form to: M. C. Blake, Jr., Mail Stop 75, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025

ber I to be confirmed. Do not write or call AGU for room reservations Free parking is available only to registered goests of each hotel as indicated.

#### Scientific Sensions

The program summary appears later in this issue. The preliminary program and the abstracts will be published in Em, November 8. The final program, with presentation times, will be distributed at the meeting. Both the Cathedral Hill and the Holiday Inn Folden Cateway hotels will be used for all disci-

Poster Sessions Poster sessions will be held throughout the meeting in the Eklorado Room at the Cathedral Hill Hotel. Check the program for detailed scheduling. AGU will provide each poster-session presenter with a mounting area measuring 4 x 6 feet (1.25 x 2 m). Plan your exhibit to fit this space. The board will be assigned by number corresponding to the presenter's abstract number. The boards will be set up in the Eldorado Room before the poster session begins. Thumb tacks, posh pins, tape, and scissors will be available in the meeting room.

The exhibits will be located on the Mezzanine, Cathedral Hill Hotel, Monday, December 5, through Thursday, December 8, 9:30 A.M. to 4:00 P.M.

The following exhibitors are confirmed:

Academic Press, Inc. American Geophysical Union Defense Mapping Agency/HTC Digital Imaging Processing EG&G Geometrics Elsevier Science Publishing Co.

Handar let Propulsion Laboratory Nathre's Own Phoenix Geophysics
Qualimetries, Inc.— WEATHERtronics Refraction Technology Schonsiedt Instrument Co.

Spreugnether Instruments Springer-Verlag, New York Teledyne Gentech Terra Technology U.S. Geological Survey

#### Social Events

An icebreaker party on Monday evening on the Mezzanine at the Cathedral Hill Hotel will be the opening social event of the meeting. To honor John W. Handin, the 1983 re-cipient of the Bother Medal, and those 1983 ACU fellows who were not present at the 1983 Spring Meeting, there will be an awards ceremony and wine tasting reception on Thorsday evening, 6:00-7:30 P.M., in the

Mactings (cont. on p. 602)

. Third Choice

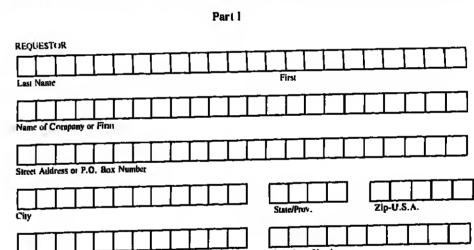
# Marican Geophysical Union M 1983 FALL MEETING

HOUSING REGISTRATION FORM

READ CAREFULLY and RETURN FORM DIRECTLY TO THE SAN FRANCISCO HOUSING BUREAU AT THE FOLLOWING ADDRESS:

> Housing Coordinator AGU Fail Meeting SF Housing Bureau P.O. Box 5612 San Francisco, CA 94101

Please print or type all information, abbreviating as necessary. Confirmation will be sent by the hotel to the individual named in Part I. If more than one room is required, this form may be photocopied.



Part II

INSTRUCTIONS: Select THREE hotels of your choice from the list of participating facilities, then enter the name on the lines below.

NOTE: Rooms are assigned on a "First Come, First Served" order, and if none of your s is available, another facility will be assigned based on a referral system. A cul-off date is in effect; your application may not be processed if received after 14 days prior lo your arrival date. AGU housing registration deadline is November 1.

#### Parl III

INSTRUCTIONS: 1. Select type of room desired with arrival and departure dates. 2. PRINT or TYPE names of ALL persons occupying room. 3. If more than two persons share a room, check twin and the hotel

will assign two double beds.

CHECK ONE		
		Opest Names (Last name (trat)
C] SINOLE I Room with one bed one person!	Arrival Date	
ODOUBLE IRoom with one bed Iwo persons)	Arrivsi Time AM/PM	to the state of th
TWIN (Room with two beds two persons)	Departure Time	3.
EXTRA PERSON	Departure time	4

IMPORTANT NOTE: Hotel MAY require a depost or some other form of guaranteed arrival. If so, inal ructions will be on your confirmation form.

#### Meetings (cont. from p. 601)

Emerald Ballroom of the Holiday Inn Golden Gateway. All meeting participants are invited to attend.

Complimentary refreshments will be served daily, at hoth lottels, 9:15–11:00 A.M. and 2:15-4:00 P.M.

#### **Business Meetings and Section** Luncheons/Dinner

The AGU Council will meet Tuesday, December 6, at 5:3tt P.M., in the Japanese Paviliun Room, Cathedral Hill Hotel.

The section lunches and dinner will be held at the following restamants: Nikko, at Van Ness and Pine; Caua de Cristal, 1122 Post Street; A. Sabella's, on Fisherman's Wharf; and the Holiday Inn Golden Gateway. Purchase your ticket now as space is lim-

#### Tuesday, December 6

 Planetology and Volcanology, Geocliemistry, aml Petrulogy, Nout, Casa de Cristal, \$9. Seismology and Tectonophysics, Nuon, Nikko, \$5. Sponsors, Kinemetrics, Inc., Teledyne Industries, Inc., W. F. Sprengnether Instrument Co., Inc.

#### Wednesday, December 7

- Gennagnetism and Paleomagnetism, Noon, Casa de Cristal, \$5. Sponsors, Schonsterlt Instrument Company, CFT Systems.
- Hydrology, Nuon, Huliday Irin Golden Gateway, \$9. Ocean Sciences, Noon, Nikku, \$9, Program: Gordon Hamilton, Office of Naval Research, will speak on "ONR's Environmental
- Science Program. Solar-Planetary Relationships, business meeting, with dinner to follow, at A. Sabella's Restaurant. 5:15 P.M., business meeting. Emerald Room, Holiday Inn Golden Gateway. 6:45 P.M., dinner, A. Sabella's, \$18.50 [Italian guurmet).

#### Thursday, December 8

• Atmospheric Sciences, Noon, Nikko, \$9, • Geodesy, Noon, Holiday Inn Golden Gateway, \$5. Sponsor, Bell Aerospace Tex-

#### Field Trip

On Sunday, December 4, 9 A.M. to 5 P.M., MANOP, Mon PM in connection with the Nano-Plate-Tectonic Symposium, there will be a field trip to the Franciscum nano-terranes in San Francisco, stressing their contact relations. The trip will he led by Clark Blake and Clyde Wahrhaftig.

The \$25 per-person cost includes tour bits, lunch, and field trip guide.

The trip, which will leave from and return to the Cathedral Hill Hotel, will be limited to 40 persons, and space will be reserved for the first 4tt to sign up. Others can be put on a waiting list, or their checks can be returned, as they wish. Those interested should send the form printed in this issue with a check made out to M. C. Blake, Jr., addressed as indicated on the form. Be sure to mark on outside of the envelope "For AGU Dec. Field

#### **Program Summary**

Orinoco & Aniazon, Tues AM Computers & Geosciences, Tues PM Nuclear Consequences, Weil AM Polar Research, Thurs AM

Atmospheric Sciences Lightming, Mon PM Thunderstorms, Thes AM CCOPE, Tues PM Effects of Nucl. Bursts, Weil PM Troposph. Chemistry I, Thurs PM Troposph. Chemistry II, Fri AM Climate & Chemistry, Fri PM

LAGEOS I, Non AM LAGEOS II, Mon PM Earth Rot./Orient., Tues AM Oceans/Geodesy/Tect., Wed PM Crustal Dynamics I, Thurs AM Crustal Dynamics II. Thurs PM

GPS & Gravity, Fri AM Geomagnetism & Paleomagnetism Theory & Anisotropy, Mon AM Recognizing Alteration, Mon PM Sec. Variat., Excursion, Thes AM Calif., Baja to Sur, Tues PM Oregon to Alaska, Wed AM Paleopoles & APW Curves, Wed PM Statistics & Sounding, Thurs AM Mehs & Conduct. Paths, Thurs PM

Magnetotell. Variat., Fri ΛΜ

Hydrology Glacier/Ocean Interact., Mon AM Streamwater Geochem., Mon PM Orinoco & Amazon I, Tues PM Gen. Hydrol, Poster Sess., Tues PM Orinoca & Amazoo 11, Wed AM Instream Flow, Wed AM General Groundwater I, Weil AM Sediment Transport I, Wed AM Gen. Hyrlrol/Stochastic, Wed PM Sediment Transport II, Wed PM Multivariate Models 1, Thurs AM Groundwater Optimization, Thurs AM Multivariate Models II, Thurs PM General Hydrology, Thurs PM Watershed Models, Fri AM Floods 1, Fri AM

General Groundwater II, Fri PM Flooris II. Fri PM Oceanography Geochemistry of Estuaries, Man AM CODE/OPUS/SUPER-CODE, Mon AM El Niño, '82-'83, Mon PM Hydrothermal Vents, Tues AM Calif. El Niño, '82-'83, Tues AM Coastal Oceanography, Tues PM Seabed Morphology, Wed AM Physical Oceanography, Wed AM Diagenesis in DSDP, Wed PM Marine Chemistry, Thurs AM General Circulation, Thurs PM Paleocea oography, Fri AM Response to Strong Wind, Fri AM Sub-scabed Disposal, Fri PM Marginal Seas, Fri PM

Surfaces & Atmospheres, Wed PM Satellites & Cratering, Thurs PM

Coalinga Earthquake, Mon AM

# Chapman Conference on Collisionless Shock Waves in the Heliosphere

February 20-24, 1984 Silverado Country Club and Resort Napa Valley, California Convenor: R. G. Stone

> Abstract Deadline: November 22, 1983

Invited reviews and contributed papers in the following general areas: Overview of the collisionless shock, macroscopic aspeds of shocks, microscopic aspeds of shocks and particle acceleration. Typical subjects to be covered include:

- Why and where shocks furm in
- the heliosphere? Shock dynamics and evolution. Shucks associated with solar activity, planetary bow shocks.

Physics through the normal AGU peer review process.

- · Subcritical, supercritical, quasiparallel, and quasi-perpendicular
- shocks. Dissipation mechanisms. The foreshock.
- corolation ahocks, and shock-· Particle acceleration mechanisms, shock interactions. Student Travel Assistance: Deadline November 30. Student travel funds are available. To

apply, write to Shock Waves Meeting, AGU, giving your educational background and your Publication: A proposal for the publication of the invited papers as a monograph is under consideration by the ACU Monograph Board. It has also been recommended that the contributed papers bs published as a separate monograph or be submitted to JGR-Space!

Contact: AGU Meetings, 2000 Florida Avenue, N.W., Waahington, DC 20009 toli free: (800) 424-2488 D.C. area 462-6903

Call for papers published in EOS, May 31, 1983

- Air Fare Information



Special AGU Discounted Air Fares Available When You Flu UNITED to San Francisco

Your toll-free number for flight reservations: 800-521-4041 (Michigan residents 800-482-0243)

#### Your AGU Convention Number 4367

Special arrangements have been made with United Airlines to offer you a \$10 discount off Super Saver fares with the 7-day minimum stay requirements waived ... only available when you call the unlisted, toll-free number of United's Convention Desk 8:30 A.M.-5:30 P.M. EST, Monday-Friday.

Just call the above number, available to those within the 48 configuous states. Ask for the Convention Desk. Tell them you are altending the AGU convention in San Francisco or give them AGU's convention number: 4367.

Here are the details on your special AGU convention fare:

- \$10 discount on the toundtrip Super Saver/coach fare in effect at the time of
- The 7-day minimum stay is NOT required.
- Travel must commence no earlier than December 1, 1983, and must be completed on or before December 12, 1983.
- Reservations should be made as early as possible. The final date for reservations and ticketing is the day before departure. Reservations will be accepted after this date, but at the higher fare.
- Ticket purchase may be made directly from United; they will mail your fickets direct to you. Just provide your form of payment when you call. If you wish to purchase your ticket through an authorized travel agency, you may do so. However, YOU, not your travel agent, should call United's unlisted number.

#### Special Note

In the current "air fare war" there may be sporadic and short-lived discounted fares from specific cities to San Francisco. These fares have restrictions and are limited. United's convention specialists will assist you in determining if your travel plans meet these specific restrictions.

AGU and United Airlines are working together to bring you a better meetingforless. Use the United Convention Desk; help yourself and AGU at the same time.

Mostly Nuclear, Mon AM Rio Cramle Rift, Mon PM Lateral Heterogeneity, Mon PM Oceanic Lithosphere I, Tues AM Earthquake Chemistry, Tues AM Oceanic Lithosphere 11, Tucs PM Earthquake Hydrology, Tues PM Earthquake Prediction, Tues PM Crust & Upper Mantle I, Wed AM Crust & Upper Mantle II, Wed PM Marine Seismology, West PM Sources & Strong Motion, Weil PM Future Global Network, Wed PM Seismicity & Tectonics I, Thurs AM Wave Propagation I, Thurs AM Seismicity & Tectonics II, Thurs PM Wave Propagation II, Thurs PM Long Period Scismology, Fri AM Tomography/Networks, Fri PM

SPR<sub>1</sub> Aeronomy lonosphere: Radar, Mon PM lonosphere, Tues AM Airgiow-Aurora Poster, Tues AM Middle Atmosphere, Tues PM Mesosph.-Thermosph. I, Weil AM Mesosph.-Thermosph. 11, Wed PM Mesosph. Thermosph. III, Thurs AM Airglow, Thurs PM Euv-Airglow I, Fri AM Euv-Airglow II, Fr! PM

SPR: Coamic Rays Cosmic Rays, Mon AM IMP 7 & 8, Mon PM IMP 7 & 8, Tues AM

SPR: Magnetospheric Physics Aurora/Substorms I, Mon AM AMPTE Program I, Mon AM Jupiter/Saturn, Mon AM Aurora/Substorms II, Mon PM AMPTE Program II, Mon PM Reconnection, Tues AM Aurora/Substorms III, Tues AM Electric Currents/Fields, Tues AM Compar Planet Msph II, Wed AM VLF Waves, Wed AM History of VLF Research, Wed PM Spacecraft Effects I, Wed PM Ion Composition/Dynamics, Thurs AM Spacecraft Effects II, Thurs AM Magnetic Pulsations I, Thurs AM Charged Particles I, Thurs PM Waves/Instabilities I, Thurs PM ISEE-3 in Magnetotail I, Fri AM Waves/Instabilities II, Fri AM Auroral Hiss & AKR, Fri AM Magnetic Pulsationa II, Fri AM Charged Particles II, Fri AM ISEE-3 in Magnetotail II, Fri PM Magnetospheric Tail, Fri PM Ionospheric Radars, Fri PM Waves/Instabilities III, Frl PM

SPR: Solar & Interplanetary Physics Solar Phenomena, Tues AM Solar Wind, Tues PM Shocks/Upstream Phenomena, Wed AM Solar Physics, Wed PM Solar Wind Int. w/ Comets, Thurs AM S.W. Int. w. Venus/Titan, Thurs PM

Tect. Sed. Active Marg. I. Mon AM Fault Zone Drilling L. Mon AM

Marine Tectonics, Mon AM Tect. Sed. Active Marg. H, Mon PM Fault Zone Orilling H. Mon PM Heat Flow, Mon PM Mantle/Crustal Dynamics, Tues \M Deformation, Tues AM Tectonic Hazards, Tues PM Tecomics: General, Tues PM Recent Trends, Wed AM Active Margins, Wed AM High Pressure Research, Wed AM Physics of Magnia Transfer, Wed PM Fracture & Faulting, Wed PM Rift Research, Weil PM Active Tectonics I, Thurs AM East Pacific Rise, Thurs AM Tectonics Poster Session, Thurs AM Artive Tectonics II, Thurs PM Himalayan-Alpine, Thurs PM Tectonophys. Poster Sess., Thurs PM Salum Sea Drilling, Fri AM California Tectonics, Fri AM Circum-Pac, Tectonics: SE, Fri AM Franciscan Godogy SF Bay, Fri PM Phys., Chemistry Minerals, Fri PM Circum-Pac. Tectutics: N. Fri PM Circum-Pac. Tectunics: SW, Fri PM

Volcanology, Geochemistry, & Petrology Califerns I, Mun AM Mineral Physics I, Mon AM Califeria II, Mon PM Metamorphism, Mon PM Calderas III, Tues AM Gases, Tues AM Califeras IV, Tues PM Orc Deposits, Tues PM Cascniles I, Weil AM Laki Bicentennial, Wed AM Galderas V, Wed PM Arc Volcanism, Wed PM Cascades II. Thurs AM VGP Potpotirri, Thurs PM Gascades III, Thurs PM Hawaii I, Fri AM Hawaii II, Fri PM Isotopic Studies, Fri PM

**Awards Ceremony** and Reception Thursday, December 8 6:00 - 7:30 p.m.

Emerald Ballroom, Holiday Int

To bonor John W. Handin, the 1983 recipient of the Bucher Medal, and those 1983 AGU Fellows who were not present a the Spring Meeting there will be an awards ceremony and wine tasting reception. All meeting participants are invited and urged to attend.

# Section Candidates

Ess is carrying biographics and photo-graphs of all candidates for President-elect. General Secretary, and Foreign Secretary of the Union and for President-elect and Secretary of each Section. In addition, statements whe candidates for Union offices and for ction Presidem-elect will appear. Candidates for the Seismology Section and an addiional candidate for the Planetology Section ppear below. The material for the sections Geodesy, Geomagnetism and Paleomagnetion, and Planetology appeared in the August Dissie; for the Atmospheric Sciences Section in the September 27 issue; and I cor the Teconophysics Section in the October 11 isme. The slate of candidates for all others was rarried in the June 21 issue.

#### Seismology: President-elect

F.A. Dohlen A member of AGU since 1968; 40 years old. Profesor of Geophysics, Princeton University. lajor interests: Licoretral seismology and mechapics, free oscillations, rotation of the earth. B.S. in geophysics, Caltech, 1964; Ph.D. in

geophysics, UCSD, 1969. At Princeton since 1978. Alember AGU, SSA, RAS. On colitorial board of The Geophysical Jonn and 1977-1979; NSF Earth Sciences Panel 1982-83; 39 publications, 6 in AGU journals. All red P. Sloan foundation Fellow 1971-1973. Canalidate Stewart W. Smith (see below) tangla Dahlen's first course in geophysics and provided his first summer job in geophysics.

#### Statement

The Seisnology Section of Atill is currendy in very capable and distinguished hands and I do not envision initiating any major shilts in policy if elected. I would use the 2-parterm as President-elect to become better informed about the allairs of the Section and the Conneil, by soliciting the views and advice of the membership and the presen and past officers of the Section. The principal function of AGU is to bister scienthe communication through its program of needings, conferences, and journals. I would be opposed to any significant change in for-parol the annual meetings despite the obvias problems caused by increasing attenance because they provide such a valuable form for students and others entering the feld to discuss their work and meet their ten and colleagues. The AGU journals are healthy and highly respected, and it is impurthe they remain so. Submission of papers in degronically encoded form, an option releady adopted by the journuls of the APS. hold be investigated. This would be particdarly valuable for heavily mathematical artite requiring careful proofreading."

Stewart W. Smith A member of AGU since 1939; 50 years old. Proessorel Geoplysics, University of Washingonversity of Washington Major interests: summity, tectonics, and oustal deformation. dusa deformation. S.R. in geology, MIT.

Physicist, Shell Oil Company, 1954-1957; Asand Associate Professor, Caltech %1-1970; Professor and Ghairman of Ceomisks, University of Washington, 1970-Alember SSA, EERI, SEG. Has been Mairman, Geophysics Advisory Panel AFOSR Director of SSA, on editorial com-Mice of Annual Review of Earth and Planciary dings on Seismology Committee on NAS/ NRC, and served on advisory committees and Panels for USGS, USNRC, EERI, IASPEI, and NSF: 41 publications, 11 published by AGU. Served as Program Ghairman for AGU Scienciogy Section.

Statement

The primary objective of AGU, and our gion in Particular, is to provide communidate ation within the scientific community and to the general public. I view the most important inction of AGU officers to be the review and evaluation of the mechanisms by which he achieve this communication to determine they are meeting our needs. Beyond the ounals, newsletter, symposia, and general meetings, we need to be prepared to utilize the new tools and the new tools. the new tools that technology can provide to thore, catalog, and transmit information. Ultimately to maiely the progress of our field will depend

on how effectively we can learn from each other. I would hope that AGU will be at the forefront in the application of the next gen-eration of communications and knowledge based systems to achieve this result."

#### Seismology: Secretary

William L. Ells-

Emile A. Okal A

worth A member of AGL! since 1972; 34 years old. Chief, Branch of Seismology, U.S. Geological Survey, Menlo Park, Calif. Major interests: earthquake seisundogy and lithospheric structure. B.S. in physics and M.S. in geophysics, Stanford University, 1971; Ph.D. in geophysics, MIT, 1978. U.S. Geological Survey since 1971. Member AGU, SSA, SEG, Sigma Xi, and JMGS. Member of Panel on Seismological Studies of the Continental Lithosphere of NAS/NRC; served on advisory panels for U.S. Nuclear Regulatory Commission and Committee on Seismology, NRC; 17 publica-tions, 7 published by AGU.

ember of AGU since 1974; 33 years old. Associate Professor of Geology & Lieophysics, Yale University (as of January I, 1984; Associare Professor of Geological Sciences, Northwestern Universityt, Maior interests: seismology. plate tectonics, imraplate volcanism, marine

geophysics, M.S., Ecole Normale Supérieure and University of Paris, 1972; Ph.D. in genphysics, Caltech, 1978. Came to U.S. in 1974; naturalized in 1982. Faculty member at Yale since 1978; will move to Northwestern January J. Member: AGU, SSA, Alom 40 mbbcations, 7 in AGU journals. Associate Editor. IGR-Red. 1983-1985; Pengram Chairman for Seisonology, AGU Spring Meeting, 1983 and

#### Planetology Petition Candidate: Secretary

Gregory F. Herzog has been approved as an additional cambillate for Secretary of the Planetology Section.

Gregory F. Herzog A member of AGU since 1971; 39 years old. Associate Professor, Department of Chemistry, Associate member. Graduate Program, Depariment of Geology, Rutgers University, Maor interests, meteorities.

B.A., 1964, Cornell University; M.A., 1965, Ph.D., 1970, Columbia University; Resident Associate, University of Chicago, 1969–1971. Since 1971, Department of Chemistry, Rutgers University. 1976–1977 Max-Planck-Institut fitr Kernphysik, Heidelberg. Member AGU, AAAS, Meteoritical Society. XRF User Subgroup Representative, National Sync. Light Source. Associate Editor, 12th Lunar and Planeary Science Conference. 32 publications, 8 published by

# Membership **Applications** Received

Applications for membership have been received from the following individuals. The letter after the name denotes the proposed primary section affiliation.

Paul Michael Abraham (S), Gusngfen Cheng (O), Donald Galys (O), Jetemy R. Henderson (S), Peter Hufschmied (H), Delect M. Imboden (O), David R. Jones (V), Stephen Lane (S), W. G. Large (O), Denis Lefalvre

#### Student Stalus .

Debao Bai (A), Cecilla Binig (T), Richard A. Degner (S), Hjalmar Eysteinsson (GP), John R. Farver (V), Vanessa L. Griffin (M), Eugene O. Humphreys (S), Eugene S. Ilton (V), Richard A, Iverson (H), Carlos Krepper

# THE TWO CAREER COUPLE

# Balancing Personal and Professional Life

## AGU Fall Meeting

Wednesday, December 7 5:45 - 7:30 p.m. Pacific Heights-Presidio Cathedral Hill Hotel

Connie Sanchetta will moderate a discussion of the problems couples face when both are active and recognized in their professional fields. Panelists will Include Mark and Mary Lou Zoback (U.S.G.S.), Alice Newman (The Aerospace Corporation), and Thomas Worsley (Ohio University).

This program has been arranged by the AGU Education and Human Resources Committee. Refreshments will be available.

## Separates

To Order: The order number can be found at the end of each abstract: use all digits when ordering. Only papers with order numbers are available from AGU Cost: \$3.50 for the livst article and \$1.00 for each additional article in the same order. Payment must accompany order. Deposit accomms available.

> Send your nater to: American Geophysical Union 2000 Florida Avenue, N.W. Washington, Lt.C. 20009

#### Electromagnetics

0770 Redio Schanography ATTENUALION RATES OF COASTAL RADAR SIGNALS AT O770 Magic Schaller Propagation Leboratory, Allenwaltion RATES OF COASTAL RADAR SIGNALS AT 25 NHZ
R.S. Lyona (Mave Propagation Leboratory, NDAA/ERL, Boulder, Colorado 803031, G.S. Barrick (Geen Butface Research, Bouldet, Colorado 803031)
The attenualion reta of the ground-wave signed with teage is a factor limiting the parformance of coestal HF reders (CODARS). We show that observed ettenuation tales are seen that Insoratically predicted rates at 25 MHz. This result, contrary to serior the contrary to the companion of troposphatic ducting above 20 MHz. The attenuation rates for various see status and discussed at a selection rates for various see status and discussed performance near 25 MHz. (Ground-wave attenuation, tedar propagation)
Rad. Sct., Paper 181557 Red. Set., Paper 151557

9773 Renote Sensing
SIPPERENTIAL REPLECTIVITY AND CIRCULAR POLARIZATION RADAE
SIGNALS AND RELATED DROP OSCILLATION AND PROPAGATION
RYPYCTS IN RAINFAL.
7. A. Soligm (Amospheria Sciences Program and Separtment
of Electrical Engineering, Skin Stets Unit otally,
Columbus, Ohio 432101, K. Aydin and V. N. Bringi
SIPPERMITS (COS) radar signals are directly related
to each other and to the medies drop size diseases of
tainfell whom the drop sizes are appointfully distributed. Those polecisation parameters are examined for
both static and oscillating seladop shapes slong with
their relationships with reinfell rate and liquid water
content mathastas derived From 20th on CDE sed reflectiv-

their relationships with reinfall rate and ingle wash content out thates derived from 20g or CDS and reflectivity Factor (2) measurements. Propagation effects at 5 band seven inguite are also considered and shown to be particularly important in CDN measurements. (Oilforential reflectivity, tadar meteorology, strengt particle measurements, groupel).
Rad. Scl., Paper 350031

TIVI CONVECTIVE FRECIPITATION EXPERIMENT
V. N. Exing! (Department of Electriani Engineeriog,
Colorado State University, Pt. Coilien, Colorado B0513),
T. A. Seligs and B. A. Cooper
Rader measurements of Engineering the Cooperative Conrective Proceipitation Experieerin. On Angust 6, 1981, the
University, of Myoning's Super hing Air rade two penateatome (at cititudes of 3 km and 1.5 km above mean and
lowelf through a convective cell intested 90 km M2 of the
CMILL rader. The siterraft was equipped 55th two twodispensional PM3 probes located orthogosality as na to view
the Felling hydromelecte clarg (heir symmetry cells (V
probe) and slong as asis orthogonal to it (IP probu).
Biliptical raledrop images were observed below should be
(1.5 km sittutad), and sonlost grampel images were
observed at 3 km sittutes. Secause of buse blockings at
the lowest elevation scans, rader date were not easible
in the ten region. Aircraft indefrop spectra mass
enalyzed to detell, and it is shown that Ing Seduced from
such spectra should be as specient equicate of the
provided the correct fore for the drop also distribution
provided the correct fore for the drop also distribution
is examined. Up and 24 deduted lyms the grampel species
ere shown to be in the eauge measured by the rader.
[Differential exclusive, grampel],
particle acceptracting, grampel],
Pad, St., Paper 180521 Red, St.L. Paper 300621

O773 Ramota Senting | Rullispeciral Passive Hicrosavo|
A SUMMARY OF RESULIS FROM THE 1(RST NOMBUS-7 SHOR DESENTATIONS)
P. Gloor sen | Lode R12, Soddard Laboratory for Atmospharite Sciencer, Goddard Space Filght Center, Greenholl, Maryland 20771; P.J. Cavelleri, A.T.C. Chengi T.T. Wilhell, W.J. Campbell, D.H. Achannsien, R.B. Leigerow, R.F. Kunzi; R.B. Bote, B. Steelle, E.P.L. Hindsor; F.T. Rarith, P. Buderardsen, E. Lengham, and R.O. Rafacellet Selected date obtained during the liret year of operation of the Scanning Najlichannel Hicrosave Rediometar | ISNRI on board Pan Hidmar? Salenting on board Pan Hidmar?

partmaters over open ordans, polar regions, and terrain. Over open oceans, those calculations have provided inferred values for eas surface temporalures, mem-surface which succeptorise water vapor in a solurn, and reintil tates. In polar regions, too let concentration, multiper lee inaction, and redating temperatures have been obtained. Thesity, the accent and exter equivalence of smok cover over terrain between calculated. These extensived smok paracters have been compared with in-site measurements of the same goophysical paracialors, where available, and the results of liness comparisons, where available, and the parameters it discussed, along with the plans for archiving them for tubesquent rescence, purposes. A description of the twee calibration and data processing scheme is also given. , Coophys. Sen., Green, Paper 101101

O'AO SCAIRCING
BIFFRECTIAN PADAR SCATTERILG PROPERTIES OF MONTH BAIL
AD BIADD PHASE IMPROMETIORS
F. Ayalm introophoric Sciences Trogram and Impariant of
Electrical Ingineering, Ohio State University, Calonbus,
Ohio 432101, T. A. Seliga and Y. A. Dringt
The differential reflectivity (10p) rudar signal
contains Information on the theps and all geness of the
phase hydroneteers. Under vertain directors ances, then,
this signal and reflectivity factor can be used to
identify the presence of hall particles. Such interprestations require involving the scattering
properties of varient year and Entres of Sydroceorus
lociuding Ice, water-coated ice, and graupsi. These heliuling Ice, hater-quarks and an analysis of the transfer are explained for their differential year sering properties shallood from ampetations using the transition of matrix method of batters and an extent property of the transition of the tra iden of this theory to 'wo-layered bootes. Differenti-natar erms settions together with circular deplication ratios are presented, and several instances of pottible fail detection by radar using Ipp signatures are illustrated. (Scattering, relat mergorology, half differential reflectivity).

#### **Exploration Geophysics**

Rad. Sci., Faper )50819

D950 Seismic Tarbods VELOCITY EST(HATES DEELVED FEDH TOREG-DISTOSIONAL ESISMIC DATA

Objocationic variods
Value ITT RETHANTS DERIVED FERN TERRE-Distributal
SSISHIC DATA
SSISHIC DATA
Koren Owner isobic Setrolaum Co., One Lincoln Center,
5400 the Freevey, Sto. 1200-th 25, Deltes, The 75240;
G.a.Y. Gardger and Rutt P. Hassell
a new computer algorithm is described by which
velocity estimate, releted to as "imaging velocity,"
in that which best describes the diffraction
byparboloid doe to a scatterer. The acattering canter
is best lauged when this velocity is used in the
reconstruction process.

The method is Essed on the 1-0 Eirabhoff summadion
signation before steel. The implementation consists of
two basic phases: lif differentiating the input Yield
tracet and resampling them to a logarithmit thes atola,
and ill shifting, weighting, and suming each resempled
trace to a range of depth levale slao chosen on a
logarithmic stale. Pash amplitudes in the resulting
lauge matria give a time T and depth 2 Irom which
velocity is obtained using the relation Paid-T-T-The
locus of constant velocity is a slanted saraight line
in the southinate system of the matrix.

In the usual application of algretion for velocity
analysis, such input areas of S samples is migrated for
each of M constant velocity lunctions requiring T x M
movemat shift calivlations. Bette new amplad presented
Bere, a constant shift is reluciated for a given
reamed. This teduces the newlet of calculations per
trace to about B, the velocity in a algolyleant
improvement to competing efficiency.

The operation of the migration is lituatrated using
systemia and physical media data.
GEOPHYSECS, Vol. 48, NO. 11

ORD Relegio methods

APPLICATION OF REIGNIC INFLECTION DETA TO DISCRIMINATE EURSDAYCH LIUNGSTATICARPY
Anits Kinwhai (Forestly Department of Berth Sciences, Onleavelry of Boorhea, India; pranently Nedles! Research Council Gentre, IVIIIs Boos, Cambridge, CE2 208, [pdis] Beleaf Kastri

9 optrelation hatveam lithology and quantitative parameters abstracted from selevic reliection date is established. The concept and methodology developed on tyophelia date hee bane successfully applied to discriminate Estween two divincana kinds of lichologies. Spartenes two divincana kinds of lichologies. Spartenes two divincana kinds of lichologies. Spartenes to demonately accompany to the sealmentary heeln to Vesters India hee base to middred, part oil with its downnastly elected to its seedlmentary heeln to Vesters India hee base to middred, part oil which is downnastly elected to its downstip while just just a 37 partenes, shele = 50 percent, sool = 3 percent, sool = 37 percent, sool = 60 percent, sool = 3 percent). These two dilicant lithologies as machinel leadly modeled using devector part which is the statement leadly modeled using devector partwo balas. Their delemis tedpostes when struttmined let liss end Irequency demain and embjected to activities of iterialment received the selection of the sool of the selection in sold the selection of the selection of the selection and lour from this power, epoctation of the selection; of subsurface of the selection of the selection

maptery bools.

1

603

#### AGU Congressional Science Fellowship

The individual selected will spend a year on the staff of a congressional committee or a House or Sanata membar, advising on a wide ranga of scientific issues as they pertain to public policy questions.

Prospective applicants should have a broad background in science and ba articulate, literate, flexible, and able to work well with people from diverse professional backgrounds, Prior experience in public policy is not necassary, although such expariance and/or a demonstrable interest in applying science to the solution of public problems is desirable.

The failowship carries with it a stipand of up to \$28,000, plus travel aliowanca.

Intarested cendidatas should aubmit a letter of Intent, a curriculum vitae, and threa latters of recommandation to AGU. For further datails. write Member Programs Division, Amarican Gaophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009 or telaphone 462-6903 ot 800-424-2488 outside the Washington, D.C., aea.

Deadline: March 31, 1984

#### Geochemistry

1410 Chemistry of the Atmosphere
HYDROCAPBON AND CAPBON MONOXIDE INISSIONS FROM BIOHASS
BURNING IN BRAZIN
J. P. Gresnbarg (Mational Center for Atmospherit
Research. Soulder, Colorado 80307) P. P. Zirmerman,
t. Metal, and M. Poliock
I field measurements of hydrocarboe and carbon monoxide
chissions from blomass bureing in the terrado (graesiande) and selva (iropital forest) regions of Breatl
In 1979 and 1980 are cheratarized and quantified,
Regional tonsequences of burning activities include
elevated battground mixing ratios of carbon romoxide
and acome, as self as reduced visibility, over axientive
arces. Global extrapolation of the emission rates of
hydrocorbons and sorbon copoxide from lesse firos
inditetee that 6 a 1012 g C of get phase hydrocarbons
and 8 a 1012 g CO may be reloased annually from
Plomass burning. Those chiasions contribute significantly to the global budgets of these getes. (Hydrocarbons, tarbon remailde, biomass burning).
The Macional Center for Atmospheric Research is the Macional Canter for Atmospheric Research is apponanced by the Mational Science Foundation. J. Geophys. Res., Green, Paper 301539

iA10 Chemistry of the atmosphere
TRACE PETALS IN DERMULA RAINATER
T.D. Jickelia (Bormade Giologicoi Station,
Ferry Roach i-15, Bernuda), A.H. Knap and
T.M. Chutch
The concentrations of Cd. Cu, Mn, Ni, Pb and
I.H. Chutch
The concentrations of Cd. Cu, Mn, Ni, Pb and
In have bees neasured in Bormada telmatet.
Foctor easiysts indicates that Fa, Nn aed Pb
have similar origies to eddic componence
dottwed trem Motth Americo. The other retails
ell behave similarity, but differently to the
actids. Sec-sait, aven effect atlomance for
tsacsionetion, contributes binot amounce of
Cu, Pb end Ze and uncestein amounce of Pre, Mn
and Cd to Atlantic ocean pracipitation.
Heah-out tatios, ceiculated from this dota
elong with earlier woosuraments of strospherte
thas same ordet es those separted from other
venoce ocean areas. The vet dopositional
fluxes of Cu, Ni, Pb and fn to sha western
morth Attantic ocean are significant compared
to reasured oceanic flux retes. However, the
wet depositional fluxes of Ps end Mn to chte
ores are retatively enall suggesting
additional inputs, white an access we depoltlonat flux of Cd euggests area acais
atmosphoric racycling of this aismeot.
FRAINWeter, trace metats, Cerrudal.
J. Geophys. Pss., Creen, Paper 101803 J. Geophys. Pes., Creen, Paper 101803

1418 Chemisiry of the Atmosphern SEALGUAL VARIATION OF METHANE CLUX FROM A CALIFORNIA

SEALGUAL VARIATION OF METHANE (LUX FROM A CALIFORNIA RICE PASSY R. J. Citerone (Mactonal Centur for Almospheric Rasearch\*, P.O. Box 3000, Bowldor, CO 80307), J. O. Shutter, and C. C. Celwiche 10 allow Increased understanding of the global badget of almospheric methane, Individual mothano sources requiry invastigation. We have researed methane enjaof almospharic metherm, individual motions cources require investigation. We have restaured methere evits sizes from a Californie vice pady during the entire 1982 growing season. A work strong seasonal dependence was observed. Nelhano emissions was observed. Nelhano emissions two highest in the last 2-3 whots habore harvest; dely emissions reached Spin./mi. Over the 100-day shason, daily emissions averaged atout 0.25 gCM./mi. higher than our previously reported valess. Attempts to entirely ginbal rice-paddy emissions must recognize the postibility of tensonal variations. Soil temperature at 10 cm depth correleted poorly with our reasured flyant; not redox potential was e more reliable indicator.

The Unitional Center for Athospharic Research in appeared by the Molitonal Science foundation. J. Coophys. Wes., Green, Paper [C] 189

INIO Thereistry of the Ithrosphora
VALIDATION OF NITROGER DIOXIDE ESULTS MEALURED HY
THE LING INFRARED NUMBER OF DM SIGATOSPHEE (LINS)
LIFERIMENT ON ALMBUS ;

J. H. Runcell It! (MASA tanginy Respert Craier, Mali
Stop 401A, Mampton, Virginia, 23655), J. C. 9118a,
E. E. Raraberg, t. t. Bordley, P. t. Bailey, S. O.
Crayson, H. Fischer, A. Girard, J. E. Marriat, end
N. F. J. Evans
ine ttS experienat launched on Ribbus 7 measured
vertical profilat of temperature and the toncentretions of Og. MgO, KMO; and MgO antreg the pariod
from less Ociober 1978 until late May 1979. That
paper dincusers the validation of remulis tron the
Mg channol and ine quality of the data, Ma
discussion Includes Channel theracterfatica,
esperiment entre and the quality of the data, Ma
discussion Includes Channel theracterfatica,
esperiment entre and to open the competitive enemeraments made in a sarles of bailon underlightm. All
bailonn reconvenants used for sergarleons were made
quing the nairs occalitation intendique and, nince Mg
meries significantly over the durant cycle, a
photochemical model was osed to time transiste the
data to the tINS time. Because of thin, the
competitions were primarily qualitative. Features
nath as profile scape and alogs of the mixing ratio
altitude distribution ere in good agreement. The
mean difference between LINS results and the halique
data is wall withing the respect the new of the error
birth the the respect the new of the error
birth the the the respect to the new of the error

in 50°K iatitude band and with photochamital model predictions of the vertical prelife. The LINS data hall within the range of provious mining ratio measurements and they are consistent elth model estimates. The talculated on-orbit precision is 0.3 pply end the aslimated assurery from significant to -2 pply over the 3 mb to 10 sb range. Assuracy degrades a higher and lower prescure feets. These results provide the tiral day-night set of MO<sub>B</sub>

J. Geophys. Res., Green, Paper 301456

f. Crophys, Res., Green, Paper 301895

INCO IERROISTRY of Recording and tobules: THERMAL HEXAMORPHISM OF  $\sin_2 \sigma_3$  (CISCONDISTLAS DUST ANALOGI J. A. Naih and B. Donn (Code 69), neTA/GStC. Graenbelt, by Except 1998.

J. 4. Buth and B. Donn (Code 69], nama/ostc. Greenbelt, bp 20791

We have apportmentally shalled the thornol behavior of Si\_O<sub>3</sub>, the rainstable condensate from %10 vapor. Of Si\_O<sub>3</sub>, the rainstable condensate from %10 vapor. Of Si\_O<sub>3</sub> hard its successor, anorphous quarts, have previously been shown to have infrared spectral features similar to see which appear in the spectral features included to see the range 7504 < I < information. This process operators over the range 7504 < I < information. This process to a unicolocular disproportionalion reaction. the rate of this transformation can be expressed as with a 10 espi-80kal/nolo/Aff. Using this rate constant we find that a significant fration of freshy nucleated execusateflur grains and survive passage through a typical direcusible in shell virtually unaltered in directors. We emphasize that this to cally the first in a sorios of issoratory experiments inlands to study the metamorphism of menty condensed firecussifier asterial ojects into the interfellar sension. Finding shell are to those might have peen increparated into the printerfer solar nebula provided that they could also survive passage through the general intersiellar nedium. [interlial).

J. Seephva. Res., 2nd, paper 185010

1440 Chemistry of the Solid forth
StittMAttR ANGRIMOSITES: A LUMAR AMALOG?
P.A. Solpas (Department of Earth and Planetary
Stiences and McDonnell Conter for the Space Sciences,
Washington University, St. Louts, Misaguri 63130).
L.A. Moskin and I.S. McGellum (1884).

Nathingion University, Si. Louis, Misauri 63130).

L.A. Meskin and L.S. McCellum

Tamples of anorthosite from Stiliwaior Complex units

Mil and AM-II were anelysted by IMAA for fe0, C.O.

May0, BEE, and other irace elements. No torposition of

irand with strail graphic position was observed. Mean

tontentral loss for rest elements are about the same

for three traversos liveo for AM-II) but C.O. Fe0, and

Sr concealrations are slightly different for the three

iraverses. The elements are not normally or ingnorm
ally distributed amond samples from a single iraverse.

from funceidered corrulations can be understood in

terms of semple electalogy. Little evidence for tom
position of estation of mienrals during Bretipitation

of the entire Middle Beaded lone is apparent. As in

land anorthesites, the composition of trapped residual

inquid is relatively lesignificant (less inan 55). in

addition to piagical ese, which makes up, on average,

90% of the smorthesities, the rots contain inter
stitlo oynaccee (augite and inversed pigeonite) and,

in some taxes, quertz, litano-magnetite, suffides and

rore apatite and alianite. There is an inverse rela
ionship beiden the amonals of oyroxens and quartz.

General compositional irends, semplified by ta-St

tysionalites indicate that the bulk of the potilitite

pyroxene apporat lo be cumulus-additumly resumably

formed of the trystellization from thron emagne actu
roid be piagiociate and pyroxene. A scali fraction

of the pyroxene and plagiotiase plus all the quortz

and other trate sinerals formed from the minor irapped

liquid composent. The irragular distribution of

pyroxene oligotysis indicates that interstillal melt

algrands abstanticity prior to final consolidation of

the ratk. (Anorthesite, irate elements, trapped

1499 General
CHENISIRY OF THE APOLLO 11 HIGHEAND COMPONENT
J. C. Laul (Oddologytei Sciances Department, Belietle,
Pacific Northweet Laboratories, Richland, Washington,
9332)

Pacific Northweel taboratories, Richlend, Washington, 93352)
Chemical dete (22 major, minor and trace alemente) were obtained by INAA for 38 hand-pit ked highland froguenia (t-20 mg) from coarse flees 10085. The Apolio II highlend chemical groups are represented by a range of pairographic types, 51s major chemical highland groups assatements of the pairographic types, 51s major chemical highland groups assatements. These are II high-tak REEP; 2) noorthaniis Hang. 5.415, 500153 with ICK chondrite REE abundancas and a positive Eu anoually and anorthosise with 30x chondrite abendances and a positire Eu enoually; 33 Ami (57073); 4) LKPM 177135; 5) arouthos tite gabbro (68415) with a positive Eu anoually, and 63 Apolie II doulmant highland compoent; 2x-10x chondrite REE abundances with a positive lox-lax chondrite anouely. Thurs are three newly recognized groupe in the Apolio II highland sulis, based on the REE patterns. These are: n) ANT with Ex rhoadrite ta, 22x thondrite flat pattern with 14x choedrite positive Eu nonoufy, and c) 2-3x Cheedrith (fint pattern with 10x chondrite positive Eu nonoufy, and c) 2-3x Cheedrith (fint pattern with 10x chondrite positive Eu nonoufy, los apoles) in posissium 100x Experiments.

Es anouely. Ins Apollo II highland suits is very low in polassium inon-KREEPy). Overail, the Apollo II singuland suits is quits siellar to the Apollo II suitin. Most praviously rategalend highland chonical groups are rapra santad in the Apollo II highland component. f. Geophys. Ses., Pad. Suppr 30523

2520 Iniorations Beimben Exterior Sourcem and Interior Proportios 1ME ELECTORAL COMMUNITY OF DIE UPPER MANTLE AS ESTIMATED FORM SAIGHTILE MAGNETIC FIELD DATA

Edno K. Uidwaii \tawranco Liversoro Mattonal Laboratory, University of Ceilfornia, Liversore, CA 945goi

Laboratory, Univarsity of California, Elwirora, CA 945501
ihe electrical conductivity of the upper mastle is estimated from los let tude magnitude tight availations(magnatic stores) caused by large flociuations in the aquatorial rieg current. The data beam is derived trom magnetic thaid magnitude data opasured by smalliles Ugo 2, 4, and 6 which ofter beiter global coverage them insubsed observatorias, in a proceedures of analysin consist of 1) separation of the disturbance train into internal and axternal parts relative to the saternal train of the disturbance train of [6]. Which relates the national variations of the enth, if) estimation of a response function [6]. Which relates the saternal warintions, due to the ring current, and iti) interpretation of the entityses response function of ing theoretical response functions for classed condectivity profiles. Some consideration is given to possible occom and conspieric effects. Bust nationates of the gadasspectic response function [6]. for 0.2 to 2.0 cycles/day instructs and paper eachie condectivity of order 10.7 5/m. (seteritie.

I. Seophys. Red., Rad, Peper 381658

Geomagnetism and

Paleomagnetism

f. Geophys. Fes., Red, Paper 185032

J. Geophys. Ros., Sud. Paper 3857730

2559 Ting variations, diurnal to secular STORM-THE CHANCES Y CHANCES BY COMMONTER CHANCES AT CROWN THE CHANCES AT CROWN LOCATIONS [9.25-559 km] AND THEE COMPARISON WITH CHANCES AT CROWN LOCATIONS [9.25-559 km] AND THEE COMPARISON WITH CHANCES AT CROWN LOCATIONS [9.25-55] AND THEE COMPARISON WITH CHANCES AT COMMONTO CHANCES AT CASE AND ADDRESS AND ADDRE 1410 Chreistry of the simmaphoro
1 MODEL STUDY OF THE EPICTS PY INTERMITTENT LOSS ON
POR NATIONS CONCENTRATIONS IN THE LONGE TROPOSPHERE
B. W. Stewart (MASA/Goddard Space Plight fenter,
Atmospherir Chooleriys Brunch, Code 964, Girenbett,
Maryloed, 29771), S. Hanend and G. Malloif
No hevo devoloped a Han-depassion two model of the
Hower troposphers whith Includes a description of photochamical and physical processes. This codel has been
applied to the calculation of intrit acid and NOx,
HON-NOy) rescentrations over a diurnal cycle which lariudes precipifation. Nitric acid concentrations and
the HNOJ/NOx rails are found to to highly variable ander
the assumptions regarding the fraquency, duratine, and
intensity of precipitation enjoyed is this mighs is
potentially supertant is eastellabing the level of
intensity of precipitation enjoyed is this mighs is
potentially supertant is eastellabing the level of
intric acid in the lower troposphera. These calcutations also ladicate that resistively large ifactor of
two) arrors may occur what the continuity equation deser libing nitric acid variations is averaged over a
durnal cycle which leadines pracipitation. Interprotation of almultaneous acasurements of HNOS and NOX
will require some isomiedge of the history of the observed air uses and may require on imporved understeeding of nightles add citragen chemistry. (Houserogenesse loss, odd nitrogen.)

f. Crophys. Res., Green, Paper 301835 Meteorology

3115 Berecompharic perhydroxyt (NO21 roasurement A KEASUREMENT OF STRATOSPHEB1C NO2 BY CROWN-BABEO wm-

1875 Berecospharic perhydroxyt (NO<sub>2</sub>) reasurement A MEASUREMEN OF STRATOSPHENIC NO<sub>2</sub> BY CROUND-BABEO un-WAVE SPECTHOSCOPY.

B. L. SoZelrs, I. Perrieh, P. M. Solomon, and J. W. Bereats, Strae University of New York, Stony Brenk, N.Y. 11794.

We have measured stratespheric porhydroxyt (NO<sub>2</sub>) using a sensitive mower recoiver to obsele epoctfoscopic time prolifes of three recursions were corried out over tour days in Soptember-October 1982 as Mauna team, Hawald (19.5 N tettude) and yteld good agreement with the column deswity and merical distribution produced above -15 km sitirude by three representative 2-0 photochemical models employing JEC 62-57 reaction rates and chanterty predictions from the ease models using WO/NABA Cremistry yield poor ogramment with our observations. Contracts between current rhootetical predictions and presions observations by Anderson, or all, are pointed out for NO<sub>2</sub> in the 28-37 km range, along with the difficulty of joining she latter with our own answerments through a monotonically varying vertical profile for NO<sub>2</sub>. I possible explanation in acresospheric water vegor toutent in suggesced. (Strassopheric water vegor toutent in suggesced. (Strassopheric chemistry, strarospheric trare Bases, NO<sub>2</sub>) J. Goophys. 28s., Green, Paper 3C1378

Itil Chemical composition and chemical interactions (Motaoralogy)
SFFECTS OF SETEROGENEOUS PROCESS ON NOS, HONO AND HONO;
CHEMISTRY IN THE TROPOSPHENZ
Briam C. He kes (National Cores for Atmospheric Rosearch, Boulder, Colorado, 89301) and Anne M.
Thompson
Ifmospheric measurements of trace oxides of nitrogen,
i.e., NO<sub>2</sub>, HONO, and HNO<sub>3</sub>, are at variance with acrepted photochemical theory. In particular, measured Nog levels at night nre lower than espected from photochemical equilibrium, observed Mun0 concentrations incremes throughout the night, and HNO<sub>3</sub> or NO<sub>3</sub> la produced rapidly to cloud and plume.

We investigate theoretically the patential role of two particles in the Themistry of NO<sub>3</sub>, HPNO, and SNO<sub>3</sub> through a model that incorporates M-N-O photochemistry and a heterogeneous scavonging parameterization. The model includes offsers due to temperature, pressure, photocoataionary exist number, photolysis raise, diffusion rate and aliching coefficient.

Application of the model to sufrable Ong case studies rowals that low NO<sub>3</sub> concentrations could result from the reaction of NO with Ong provided No is present at night. However, in the absence of NO low NO<sub>3</sub> can result term huserogeneous loss of NO<sub>3</sub> and SpO<sub>5</sub>, provided their sciching coefficient.

In the study of NOW we find that a nectoring produce.

In the study of MONO we find that a necturnal production by heterogeneous \$40 reactions is insufficient to account for observed levels of HONO.

Nodel sensitivity calculations desonates that the formal ion of MONO or MONE for the desonates that the consistency of MONE for the description of MONO or MONE for the MONE formal ion of MONO or MONE for the description of MONE for the total of the formal formal formal descriptions and reaction of money description of MONE for the MONE formation and reaction of money description and m

3715 Chomical somposition and chemical interactions THE AIMOSPHEDIC CHEMISTRY OF HLOROGEN CYMHOE (HCN) R. J. Cicerone (National Center for Almospheric Researche, P.O. Box 3000, Boulder, CO 80307) end

R. J. Cicerone (Notional Center for Atmospheric Researth, P.O. Box 3000, Boulder, CO 80307) end R. Leliner
Since 1981, three groupe have raported spectroetopic detections and mensurements of hydrogen cyonide ie the atmosphere. HCM concentrational (volume mixing ratios) of (1.5-1.7) x 10<sup>-12</sup> appear to characterize the strate-sphere and the northern hostsphere's nonurbae troposphera, in this paper, me explore the atmospheric behavior of HCM by examining lis themical and pholochemited praperties. Its principal almks ere reactions with atmospheric OH ead O('0); precipitation appears to be a negligible sint, in the stratesphere vacuum Uy photome also attack HCM. Atmospheric model calculations show that HCM sould be resisively well mixed in the troposphere and that its contentration docrease alonly with altitude is the etraiosphora. Its atmospheric briden can be a menual acurco of about 2.5 years is a possible range. To maintain the observed atmospheric burden of MCM, an annual acurco of about 2.5 iol' g nitragen on MCM is required; as speculote as to the identity of these sources. Oxidation of NCM by OH, while the mojor sink for atmospheric HCM, is not simple or direct. Include, oxidation proconds from the MCM-OH adduct forced in MCH + OH reactions. These pothways and thair uncertainties are oxilined here.

The Molitoni Conter for Atmospheric Romospheric services and the second and

Tha Moliconi Contar for Atmospheric Romoarch is sponsored by the National Science Foundation. J. Geophys. Mas., Creen, Paper 301570

1720 Climatology (Semattivity to CO., iroreem) IMPLUMNCE OF OCEANIC HEAV TEAMSPORT OFON THE SEMBILIVITY OF 1 MODEL CLIMATE SEMBITIVITY Of 1 HODEL CLIMATE 2. J. Spalman and B. Manaha (Geophysical Pluid on it appears mu o, manuse (Geographes I into Dynasics Laboratory/MOSA, Princetro University, F.O. Sox 106, Princeton, Nan Jersey 03540) The infimence of oceanic heat transport on the asset-Sox 108, Friaston, Nam Jersey (8550)
The influence of oceanic hest transport on the asseltivity of clinars or an increase of the atmospheric CO corcentration to acudied. For this purpose, the CO\_laduced changes of two estimated models with sed without the effect of ocean currence are compared. The tirst model is a Memoral circutation model of the coupled stans-atmosphere system which includes osseed currects. In the second model the oceanic component of the first model is replaced by a simple mixed layer without ocean currents. Both models have tolted comporation ocean currents. Both models have tolted comporation in sociation. For each seded, the memority of clinate is evaluated from the difference hetween the equilibries tlimates of the mornal CO, and tror thouse the normal CO, currentrations. The memority of the two models are experted to order to levastigate the luftronce of occounts hast transport on climate sensitivity. The results indicate that the presence of the two models are experted to order to levastigate the luftronce of occounts hast transport on climate sensitivity. The results indicate that the presence of the surface at the surface at the deffect and the surface at the constitution of the surface at the deffect and the surface at the surface and the surface at the surface and the surface at the surface and the surface at high talludges, whifter poleward the surface and th

1/35 Electrical Phenomona, MBIPOLAR DIFFUSION IN THE MIROLE ATMOSPHERE 1: Taur and R. Robie (Mathonti Center: for Atmospheric Research\*: Ooulder, CO 80307] 

in the middie obmosphere above 60 km the siction concentration increases with allitude, reaching when 100 im. In the deptime tenespheric E-ragine according to the middle of 1013 m. In the deptime tenespheric E-ragine according to the middle of 100 im. The niccitons are after orbit than the feet and diffuse more rapidly through the neutral sending and electric field to develop that acts to relard the electron diffusion and sphance the conduction terroni of ions. He was a global smally avaraged numerical model of almospharic electricity irom the ground to 100 km to examine the effect of ambipolar diffusion and the earth's geomagnite that on the currents and field in the middle obsopher, the results show that above about 65 is sublipolar diffusion generates total electric fields and conduction currents what belone electran diffusion currents have about 65 is sublipolar that the diffusion generates total electric fields and conduction currents are feed of control of capatitude longer than the workled trieds as for currents calculated from the dommand appling of the locot electron that is the sublipolar diffusion does not electron that all the control of capatitude longer than the control of the substantial of the latest that the latest electron diffusion does not electron that the latest electron diffusion currents its to be deed to electron that the latest electron diffusion currents its to be along the electron diffusion currents its to be along the first that the latest control of the substantial controls its to be along the electron diffusion currents its to be along the deed to the control of the substantial controls its to be along the deed to the deed to

the Notional Center for Almospharic Research is sponsored by the Matienal Science foundation.

J735 Electrical Phenoena COMMENTS ON MEASUREMENT SP THE GLOBAL ELECTRICAL CIRCUIT AND THE SY-MIRE POTENTIAL VARIATIONS AT WACLOPS ISLAMP R. HAYSON (Conter Cot Space Research, 37-241, Massachusetts Inetitut of Technology, Cambridge, Moseochusette H213) This mopet discusses the problem of towar steephers control the variations of elecapheric potential with silltude. This prevent colorate wotion with convection, polistion and elecation is to june with convection, polistion and elecation wand elfocts such on the sea bress. Analysis of "Hy-wire" telhered belloos potential mesouroments by Noiworld (1983) indicates that increases and decreases occured coincident with moteorological variations have been accorded to a the global circuit in represented by the Catnogic cussel is company with the hourity average of the tachese believe patentials there is no correlation. For the abrupt drops in potential iwhich occurred coincidest with the braskup of fog or discontisuocion of the motning rise to Competative with the hourity average of the techned billow patentials there is no correlation. For the abrupt drops in potential iwhich occurred coincidest with the braskup of fog or discontisuocion of the motning rise to Competative the subrupt drops in potential indicative will require more than 500 of the several theated global circuit sold require more composed in the global circuit will region inspercedere and the Wallops telendround the global circuit seriation. The exceptive with this measuring sechniques potentials at 530 m were 481 highes then comprable attention of his variation was a serial consumenta. Extrapoloted to the lengths, that tethered bailoon potential potentials and 500 hV which is well beyond values posecuel in other programe. (thonopharic placetic fields).

J. Geophys. Rus., Green, Fapor Lieft

3755 STAVITY MANNER, LIMBS, MAN COMPRESSIONS ARE:
SINPIFIED DESIVATION OF AN ALDOSTISS OF DESIGN
(ANDITY MAYIN
J. Welforton E. (Buttonel scennic and Atmospheric Addi-instruction, Americanny Laboratory, Boulder, OD 6000)
A simplified proof in given that the linear disper-ation relation for gravity waves is converted taxes
nord incar relation by making the replacement to - \*\* t · for - ben - til t, whore or to the wave frequency

h. In the wave-ractor, or in the most flow, and & it ! h in the sussements, a in the most flow, and \$\frac{1}{2}\$ invollents damping rate sapificity determined by \$\frac{1}{2}\$ involved in the first services of them from a prediction for the first browlets as well as relative dispetation. Suppose to the present a derivation that does not require previous familiarity with the studiofical tests of arrong nonlinear interactions, and to see explicitly reveal the underlying assumptions and appealability of the first provail the underlying assumptions and appealability of the second of substance, is that a specific avarage in anough instance of substance, is that a specific avarage in anough instance of a to that extrape the support of the service of the second of th slowly, to wave lengths esticiting & E >- 1, and D wave amplitudes that are too large to be treated Po weak mode-coupling theories. I. Coophys. Mes., Bing, Paper 341367

J770 Particles and Acrotols (Arctic Hata)
MASS SIZE BISIRIBUTION OF CHEMICAL CONSTITUENTS of DI
MAINT ARCTIC ARROSOL
R.M. IDET (ALmospheric Environment Serate, 405
Outforin Sireet, Downayler, Onterio, Canda RM Mills
M.M. Lositch, P. Fallin, L.A. Serric
Ywo field experiments, one from Howenber 2tHocosbor 14, 1931 and the getond troo fabruary 14-22,
1992, word conducted at Iglosite, Methest
iorritorics, Consade, to sludy the composition and sust
a teo spectrum of cretic haze acrosol. In addition,
mosaucomonis were made of supply disolde and
euiphote. Naam size distributions was obtained for
CIT. ROS, SOJ, Mg \*\*, NH2 and for alcomoted for
Na, V. Rn. i. Br. The marine corporate components at
lorger particle elees is separated troo the
onthropogenic ecrosol component of smaller particle
nines. Anthropogenic components (MH, SO4,
V. Mn) mare bound predominantly on sub-elementra
onerosols. Morine components (CIT. Na\*, Mg\*)
ore predominantly suppress romater in size. Steulis
ore oreacons and indicate that in gas phane
component or precursor may exist in the Arctic.
Oltferent transport during periods of the ferrary
Asle. SO, was found in concentrations to the
explemention for the SolySoJ concentration
rolle are given. (Point aerosofs, Size distribution,
rolle are given. (Point aerosofs, Size distribution,
Cheelcel characterinlics of Arctic aerosofis).
J. Guophys. Bas., Grava, Papar 301540-

1984 AGU SPRING MEETING
May 14-18
Cincinnation
Ohio ABSTRACT DEADLINES For more information or to be placed on a special mailing list, write to 1984 Spring Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC

20009. Call for Papers to be published In Eos, November 15, 1983.

#### Mineralogy, Petrology, Particles and Fieldsand Crystal Chemistry Interplanetary Space

IND Antegraphy and Pourogenenia
INDEXT of EIGH-RO STAFE FROM THE BEARTOOM
STATES, WERTHAL & SEARCE FOR THE PARFET
REAS OF THE STRUMARTH COPPLEY
1. Look look of Cology & Goophysics, late
into, we haven, CT OOSHIR, J. L. Wooden and
E.R. Gopfager
Six preshratify distinct groups of Fracambrimighting dives have been examined to determine
it are could have been a sample of or structly roleed to the parent magne of the Artilivator Complex
big two groups have sufficiently magnesian oftisize and attemperates, but meither of those has
afficiently ratile pinglociano. In terms of
adjor strust there appear to be only two
distort argus typest one has a high orthofacts beautiful the Bushweld Camples, of South
white; the strong and all part the Great Dyko
et Eights and the Bushweld Camples, of South
white; the strong at a staff are no printing thelittles with higher plaglociano and allopation comrous that the first. All in the groups are content to the first. All in the groups are
consisted consamination (30-502) of fractionstry kraditic segments consulation with the
last segment the constant with the
list sagment the proper content in the
list sagment here over the same of the parental
capits of the targe invarient constant with the
list sagment the proper of the parental
capits of the targe invarient properties of the
lists against the targe invarient the parental
capits of the targe invarient of the Tundoms.
J. Looyte, Etc., Bod. Paper 188083

this bundary layer and exchange processes

LICERT CHEFF HEASUREMENTS IN 1 WHD-WAVS TAKE

Lit the No. Cad-et-Hak (Flow Researsh Company,
Ect, Vishinghon, RED124

Liboratory espet inouins were conducted in a windwin ink to study the turbutnut cheracteristics

it is air and water boundary-Layere generoted by
win ted were. The turbutnut air boundary-layer
cas the water mortace was surveyed using two holmine grobel. It was found to be a good effundation
is attocheric boundary toyer over a body of water.
Chalance probes were used to record the wave height.
Forts, was probes were used to record the wave height.
Forts, was probes were used to record the wave height.
Forts, was probes welletty, dormant wavelength
all imprises and other statistics of the wind-waves
was attempted. The water boundary signs below the
ways attempted. The water boundary signs below the
ways attempted. The water boundary signs below the
was attempted. The water boundary signs below the
was attempted. The water boundary of two transfers was current and transfers was current and transfers was current and transfers was current and transfers were computed. Similarity prolities were
tell by the mass subsurface current and the RMS
industry the transfers was continued as relating importance of the wave-induced motion,
which its mass subsurface current and the RMS
industry the transfer of the wave-induced motion,
which its mass subsurface current and the RMS
industry the transfer of the wave-induced motion,
which its mass subsurface current and the RMS
industry the company of the wave-induced motion,
which its mass subsurface current and the RMS
industry to the processes of the wave-induced motion,
which its mass subsurface current and the RMS
industry the processes of the wave-induced motion,
which its mass subsurface current and the RMS
industry to the processes of the wave-induced motion,
which its mass subsurface current and the RMS
industry to the processes of the wave-induced motion,
which its mass subsurface current and the RMS
industry to

of chierophi the system and changes in the distribution of chierophi the system and changes in the distribution of the chierophyll concentrations and the intensi increase in chierophyll concentration are respectively. A '5'-shoped band of high chierophyll was present sell off-shore of the Orange distribution and lends support to the existence of a distribution zone of the shelf freal is the area; there is the area; there is the area; there is the area; there is the area is the area; there is the area is the area is the area; there is the area is the area is the area in the bays in the area of clevated chlorophyll were ordered in the bays in the area of clevated chlorophyll were ordered to the earlier opening event to the region is the subjections for future work to the area are discussed. It copye. Rep., Green, Paper 3CISCI

1. Groden, Res., Creen, Paper 301376

and Crystal Cheffitts by

and tracked above and periodry
got intellected as Felderal Cavetals
got intellected Cavetals
got intellected
got intellect All the many has effects.

"An PRODE IS IN 151th April 15 (19) A product of California. San Prode IS to Such across the California and Califo 1. Leophys. Son., Ped, Paper 365026

#### Particles and Fields-Ionosphere

SSIO Aurorei egne magnetit etfects
NEMISPHERICAL JOULE NEATING AND THE AE INDICES
M. Beamjehann (Jax-Planck-Institut für extraierrastrische Physik, 8046 Gorching, H-Germany)
and Y. Kamide
A ilmoar regreseion analysis ot Joule energy
deposition rates integrobed over the narthern hamisphera
es a function ot the sienderd euroral sleetrajet indices
yields a correlation toeftitient of r = 0.7 - 0.9.
Except tor very disturbed tious, when the AE(12) indax
iends to underastimate the Sieciralet current, the hsalapheritei Joule housing rate can be eleculated by substituting in I in the AE index by approximately 9.3 GM.
This scale foctor is appreciably larger than those
employed in earlier energy copyling studies. A higher
scale factor is found for the regression between Jaule
honting toused by éastward current versus AU. This
is consistent with typically lower ionospheric coeductivity volues in the ensistent electrojel region
which require higher electric fields and thus more
Joule heeting for a given onsivered current or AU value
than for the same intensity of the westward eletrojel.
(Auroral zone magnetic effects, high-latitude ionoapheric currents, Joule heeting).
J. Coophve. Ree., Blue, Faper 3x1542 J. Coophys. Res., Blue, Caper 3A1542

into the bare a smaple of or finesty relast to the paren sage of the Artifletter from these has
deep the pump here artifletently memels of the
data of suppayments, that suffice of these has
defor threats there appear or be noty to
the control of the pump the suppayments of the pump the
difference of the pump the suppayments of the pump the
difference of the suppayments of the pump the
difference of the suppayments of the pump the
difference of the suppayments of the suppayments of the
difference of the suppayments of the suppayments of the
difference of the suppayments of the suppayments of the
difference of the suppayments of the suppayments of the
difference of the suppayments of the suppayments of the
difference of the suppayments of the suppayments of the
desired the light-suppayments of the suppayments of the
desired the suppayments of the suppayments o

His Graral (Unvaling)
BI MAGC-7 (ZCS EXPERIENT IN THE BENGUELA CURRENY
History (ZCS EXPERIENT IN THE BENGUELA CURRENY
History Gurdenn Africa, Ferniary 1980. PART 2:
I. I. STAND OF PHAGERI AND DEAROGAPHIC HAP (CATIONS
I. I. STAND (See Inharden Research institute, Privata
2: 2. Acquire (See Inharden Research institute, Privata
2: 2. Acquire (See Inharden Research Institute, Privata
2: 2. Acquire (See Inharden Research Institute, Privata
4: 2. Acquire (See Inharden Research Institute, Privata
4: 2. Acquire (See Inharden Part (See Inharden)
1: 3. Acquire (See Inharden Part (See Inharden)
1: 3. Acquire (See Inharden Part (See Inharden)
1: 3. Acquire (See Inharden Part (See Inharden)
1: 4. Acquire (See Inharden)
1: 5. Acquire (See Inhard

emilysts of Chm | ecitudinat profite of the selection field.

The telitudinal profits is compared with the predictions of the semi-enetytirot convection model of profit and the semi-enetytirot convection model of semi-enetytirot convection model of the semi-enetytirot convection model of the semi-enetytirot convection and the conformal semi-enetytirot convection of the semi-ene J. Ceophys. Res., Blue, Paper 341550

S530 High-ieticude loneapherit surrench ELCTRIC PIELD AND PLASMA GENSITI MEASUREMENTS IN THE AMERICAL HIECTRONET R. P. Pfeff (Echool of Electrical Engineering, Occasion University, these, New York, 1483); M. C. Kelley. B. C. Pejer, E. Endott, C. N. Carlech, A. Pedersen and B. Hanaler Internse alectrostatic waves in the surroral Frington have been detected significancessiy on two payings Iconched in a onther daughter coeffiguration from

Dr. John Dos
Department of Earth Sciences
USA University
Weshington, I/C 20000

Dear John.

I know that you ere scheduled to give testimony in a lawsuit
next manth, lieve a great book for you to read before you go
next manth, lieve a great book for you to read before you go
the court.

The Scientist and Engineer in Court.

At both realize that this courts increasingly are into court: The Scientist and Engineer in Court.

You end I both realize that the courts increasingly are settling disputes which deal with significant technical each settling disputes which deal with significant witness—such scientific questions and call upon an expert witness—such seterific questions and call upon a expert witness syourself—to analyze scientific deal or robe a truly set syourself—to analyze scientific deal or only to have prepared witness, the scientific is required not only to have prepared witness, but also needs to understand court on the leading of the court of the leading of Communication with the purple or pury.

The Schoolst end Engineer in Court clarifies the elements of levents, defines common is get terms, and utters a practical levents, defines common is SThis volume—written by Stewarts, defines common is set the published by AGU. Cive AGU ide is court from proceedings are published by AGU. Cive AGU trologist, Michael Bradley—is published by Krightour to you.

1 (800-424-2488) and they will get this book right our to you. The Scientist and Engineer in Court (1983) by Michael Bradley —111 pages • \$14 • 30% member discount— American Geophysical Union 2000 Florida Ave., NW Washington, DC 20009 Orders Under \$50 Call 800-424-2488 ntust be prepaid

202-462-8903

accepted.

E628A3

Miruna, Sweden. The data sets cooprise electric field and density measurements from the roblem! (MC) conditions to fluctuations as high as 50 MHz. The DC electric field assured by both payleads was 54 MHz enrithwer, which corresponded to se electron drift valocity of 1085 m/sec. This electric field drove two-atream waves perpendicular to both E and E observed by both spacecraft throughnets an altirude region which agrees quite well with the range predicted Py Itnear rwo-atream theory. The power in the wares depended on the electron deselvy gradient, delinishing mear fo? he where the gradient changed direction for a from tituneters. This observation is consistent with a Ryredient drift wave contribution to the lastability process eince the surers long geometry dass pormil a reappoint of the electric field perpendicular to E to he parallel to the vertical electron density pradient. Electric field spectre corroboaste there requite as a strong component was desected at longer wavelengthe (everal hundred roters), the spectral regime sesociated with this inerability. The spectra rocaused ro both paylrode eion reveni en anhanced rocaused roboth paylrode eion reveni en anhanced rocaused roboth paylrode eion reveni en anhanced rocaused for the layer (120 kg) which elec appears as electrotectic and parallel to the rocrent. This spectral froture may be the tomsequesc of a sarrow range of wavelengthe assetted own the two-atream tostability threshold. Deatending through the layer, she fluctuations fift rot to a breadhand, turbulent spectrum, setanding to estie sites down to the order of cantiescers. Long wavelength wave fore the strongest spectral component below 185 he. Power observed perpendicular to the direction of the norvest laditatra the presence of a sarrow range (Passas lassibiliciae, electrojet, wave assuraments).

J. Geophys. Rea., alue, Paper 31593

fengths longer than 5 e and do not propagate in quital right direction for desaction by our reduct. The threshold for the waves thet we observed le considerably bigher than the sinking. Intense localised currants, each as those known to be associated with surgers curis and rordices, if 2 10°-CuA/m² eppear to be sufficient to excite the longer (-10-20 m) ion cycletron waves is the upper E region whether or not the field slighed effects of the sense sufficient to excite the correct ears ever ferme enough to sectic directly the 3 e waves we observe the an open quention, but there is at length surgers and successful and the life Alaska conditions. (Aurors, plasma news).

J. Coophys, Ras., Eice, Paper IAISIS

1. Coophys, Ras., Eice, Paper IAISIS

1. Sold Latterdinal profits

Layinders and M. Bison (CRENVEST. 38-40 ivenue du la latter and M. Bison (CRENVEST. 39-40 ivenue du latter and M. Bison (CRENVEST. 39-40

3316 High-lailuides lonospheric curreets
tATITUDINAL VARIATIONS OF JOULE HEATING DUE TO
THE AURORAL ELECTROJETS.
M-t Duboin ICRPE/CNET, 3h-to rue du Genéral Lecierz,
23131 lasy les Moulineaud, Y. Kamide.
Empirical scaling isctoré between the height-integrated
louis-heating rare deduced iroin measurements of the
Chetanitie incoharent scatter rader and the square of magnetic
circulated for different situations the scattward and westward
electrojets and daylings), ere then use to assignate the Joule
heating rate elong the lailuiginal actent of the surroral oval on
the basis of magnetometer data from the laid's Afairin metylisin
heating rate elong the lailuiginal actent of the surroral oval on
the basis of magnetometer data from the laid's Afairin metylisin
heating coherence of the lailuiginal actent of the surroral oval
(April 12, 1972) is estimated to be 2,8 10 1 Joudes. (Joula
heating surroral oval).
J. Camphyes, Ree, Elde, Tapar 14,624 J. Casphye, Ree., Elde, Peper 141626

5535 Interaction between waves and particles The Northean Gymphedolance interaction between and coberent my waves propagation at an arbitrary angle with respect to the Farth's Machine

MELO

1. F. Bell (Space, telecommunications and Redioscisoce
leborarory, Stuntord University, Stanford, California, i. F. Bell (Space, telecomunications and Radioscience leboratory, Sconbord University, Stanford, California, 9405]

A theory is presented of the conlituent gyraresonance interartion le the augmetosphere Petween energatic electrons and coherent TLF waves propagating at an arbitrary angle with respect so the sarrh's magnetic lield 80-th particular, we examine the phese trapping (FTE cochamism possibly responsible for the generation of VLF missions, which involves the phase v between the right-hand rircularly polarized component of the wave magnetic lield perpendicular to 8, and the component of the search and rircularly polarized component of the wave magnetic lield perpendicular to 8, and the component of the search and if an extension of the developed in earlier wark levil, 1983; Dysthe, 597t; Nurm, 1974] involving the special case in which 6 = 0. The massended theory predicate these for any finite value of 6 there is a range of resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle, a, icr which v to not resonant particle pitch angle a, icr which v to not particle pitch angle a, icr which v to not particle pitch angle and a contail PT and regions of anomalous PT in which a contail pitch and the wave inquency, the trapping faquency than a contail PT and regions of anomalous PT in which a, a contail PT and regions of anomalous PT in which a, a contail PT and regions of anomalous PT in which a, a contail PT and re

S335 interactions between waves and particles
1 TROSETICAL HOBEC STUDY OF OBSERVED MARKETICAL HOBE STUDY OF OBSERVED MARKETICAL HOBE ALVANS AND REPRETIC EXECUTOR PRECIPITATION EVENTS IN THE NACHETOSPHEMS
2. C. Chenn (Spece, Telecommunicocione and Radioscience
Laboratory, Rismined Datedesity, Michael , Celifornia

E. C. Grammy (Space, Telecommunications and Androstiente Laboratory, Htmland Dutwessity, Stanford, Colifornia 94301) and U. S. isas:

A recently estended test-particle indetection is the significant of the gylormacoence wave-particle indetection is the significant operations with the content of the significant of the significant of the communication of the communication of the significant is computed on the significant of the communication of the significant of the

604

40 Th

1

1.4

605

-j ...

21.0

5535 Intoractions betwoon waves and pettiofes CUPRELATION OF ADMORAL HIEB AND UPWARD ELECTRON STAMS BEAS THE POLAS CUSP C. S. Lin and J. L. Burch Dopartaget of Space Sciences, Southwar Research Institute, san entonic, TX, 782841, S. O. Shawhar and G. A.

entonic, TX, Tazzell, E. C. Shawhan and C. A. Gurnett.

Simuftaneous pleama and wave data obtained by the OR-I matelfite are used to study a correlation betwoon effectrostatic aurorat hims emissions at severef kis and upward electron beams at allitudes betwoon 2 and 4 Rg aner the dayelds polar cusp. Among five randomly selected DE-1 peaces, intense effortrostatic hims emissions at Erequencies below the offectron plasma frequency are touch to be associated with several payers at each to be associated with several payers and electron beams for every pass. The troquency-time spectrum of surveil hims mear the polar cusp is sometimes characterized by a funnal shape, suggesting that the radiation is ealttel from a wave source below the speccyclift. At the center of the echanced wave ragion, the electron distribution tunction bove 50 eV is characterized by two cumponents: A hot Nazwellian component and an oppara electron beam. The beam generally have a peak energy around 50 eV, a temperature around 50 eV and a donetty of the order of 1 cm<sup>-1</sup>. The observed distribution functions are litted by a drifting Maxwellian function for the balactern reason and an isotropic Harmotian function for the hot component. The supriscally fitted plasma parameters are then used to solve the linear dispersation equation of sicritostatic waves. The instability analyses indicate that whistler waves propagating with mare normal angles mear a small resonance come can be easily welled by fow energy 1:108 eV; upward slectron beaus. The frequencies all isote growth rates are found below the efectron plasma frequency, is agreement with the observations. Based on the model that ousp miroral bies emissions are while the works truperfol electron beam, polar cuspi.

1. Ceophyn, Res., Blue, Faper 1Af549

SAAS I on our pherit Of attachances CALCULATED STORMING VAREAYFOVE IN PLASMAPHRAIC THERMAL 10V COMPOSITION 6. J. Willer Rubbratory for finetary Attacaphers, MASA/Goddard Space flight Center, Creenbeit, WD 207111, N. 4. Wave and I. Martte Rodel calculations describing stormine variations in ion composition, The model storm is delicated by high laritude the tempospherit heating which generates metidinal winds that carry neutral species, no-manua, and senge equatorward. The thermosphere arts on the plasmasphere through collisional transfer of macentum and incomp chemical reactions heaven materal species end ions. Over latitudes near the region of thermospheric beating, the thermosphere-plasmaphere caufiling processes cause on/hartenest in the dessity of exygen ions while protects are being lost. Westwhile, dessities of oxygen forms and protons mear the equator are increasing segether, almost in phese. The largest schancements in Ion density develop at latitudes near 485° invariant for both oxygen and hydrogen. Ifon composition, ion fluxee]

556] Pleans Motion, Convection, Eirculation 1-tAMER IOHIZATION PATENES IN INE POLAR CAP E.J. Weber (Ioeocpheric Physics Eranch, A.F. Geophysics Laboratory, Mancon AFB, NA 01731), J. Buthou, J.G. Moore, J.R. Sherber, R.C. Livingston, J.O. Wieningham, eed B.W. Reinisch.

eed B.W. Reinich.
Croued based optical and digital innoconds restureness were conducted at Thule, Greenland to resture ideospheric structure and dynamics in the eightling pairs cop F layer. These observations thousal the existence of large scale (200-1000 to) platry pointes detiting in the eart-summero direction during a coderately disturbed [fp / 4] period. Similaseous Symmics Explorer (DE-81 tow Altitude Piesna Inclument (LAPI) reconstructures that these patches with past dentities replorer (OE-8) tow Altitude Piesca intirument (LAP) resourcements show that these patches with pack dentities of - {OB electer are not leadily produced by twestured particle pretipitation. The LAPI readsurements those duriform procipitation of paler rain electrons one the polar cep. The co-thined measurements provide a comprehensive description of patch thrusture and dynamics. They are produced near or equatorment of the deside ourself some, and convect aerost the point rap in the anti-summent direction. Grodients within the large scale, drifting patches are twicted to attending by convective instabilities. Unfortunitation and spaced receiver recognizements are used to may the requiring irregulerity distribution within the patches. (F-layer, polar Cop, lossphere)

J. Goophyu. Res., Blue, Paper Jaiffig

5560 Wave Propagation (Propagation shrough ionospheric Oublid)
PURSE DISFORITOR AFFER PROFAGAING INSOURCE AVIOCOSPHEOFE SUREY

W. R. Tachar (Department of Flectrivel Engineering, University of Hilmele et Urbana-Chaopeign, Urbasa, thinnis, 55601, K. C. 78h

As tocompheric bubble is lirst modeled based on in afte data coccured on hoard a satulfite. The effect surfue bubble now have on radio signals propagating through it to sext simulated by Solving mutarically a parabolic squated. Considerable pulse distorting is found. When the computes local technique is applied to a frozen but nowing bubble, these results imply that the fulse oxides scribent time, the pulsefelds and its shawmass will fluctuate with lise loading to the prise filter problem cytan observed experimentally. Polse, propagation, inneghoric bubble, innospherts selective. Mad. Sci., Paper 351537

5559 Copered [Rigotron Densities] BOLAR CAP ELECTRON DENSITIES FROM DI-1 PLANKA WAVE ASSETVATIONS
And M. Formoon (Dapt. of Physics and Antropony, The

University of Lowa, lows City, IA 5224f], Donald A. Gurnatt, and Stanley D. Shawkan

Ejectric field appartus meseurecounts from the Piscow Woom Lostrument as the Dynastes Sapierser-I epecectait are used to study the local electron dessity at high elititudes in the corthern polar cap regioe. The electron density is detarmined from the upper cutoff of whistler mode redistion at the electron plasma frequency. Radian dunsity values over the polar map at L greater them 10 are found to many from 35,2 2 8.5 tm<sup>-1</sup> et 2.1 Pg to 0.99 1 0.51 mm<sup>-3</sup> at t.56 Rg.

The standy state radial outlion model is examined for consistency with the observed dessity profile. A power law if it the radial sariarion of the electron density yields an supponent of -3.85 ± 0.33, which for the radial outlier model implies a flow venocity increasing meerly linearly with intensing radial directions. Compacison of the observed electron densities eith theoretical polar wind densities yields consistency with the compacison of the observed electron densities with low-sitilude density profiles the profile at 1.16 Rg and between 1.55 and 2.0 Rg. The changes in the density profile suggest that changes octur in the best cadely transporr processes at these sitilodes. (Folar cap, density profile).

5589 General (lonoupharic Hodification)
HT-ENHANCED PLASMA LINEE IN THE LOWES NOROFHESS
E. T. Djub (figure Sciences tab., The Aerospace
Corp., E. O. Lox 97951, BE/E355, ima Aegelaa, CA
DOOD91
The lonoupharic modification facility at
Aracibo, Fuerto Sico has been used to study
langmuir waves seelled in the lower ideosphers by
a bigh-power HF radio wave. Measurements of
HF-enhanced plasma lines have been made to the
lower F region (<160 hm allitudal and in the S
region using the 430 bile todar at tracibo
Observatory. Those measurements conglement
observatious made in the paer at bigher sithtudes. Echanced plasma line spectra observed in
the lower Y region peat at the so-called "dacay
line" and contain additional spectra intructure
similar to that found in the uppor F region. In
the E region the spectra enhibit marrow peaks
located at 430 & figs. Where fog is the
frequency of the modifying HP wave. While strong
plasma line enhancements are commonly observed in
sportable S, only weak schencements have been
desteted in the normal daytime S layer. Candidate machine loss of the S-region enhectments
leaded the osciliating two-stream instability
and direct conversion of the SP wew ioto
Langmuir revos. Honoupheric modification, HY
radio reve, S region, Sporadic f1.
Rad, Sti., Paper 181851

Side General (Pleans Structuring)
ELECTROMAGNETIC TREDGY OF COLLISIONAL INTERCRANCE
(BETABLILIYES

A. J. Olsessen and J. L. Spering (JAYOOS, f.O. No.
Silés, Son Disgo, Celifornia Efile)
Ficite parellel wavelength is shown to have a
significant effact on the linear growth of isatchilisies
of the Raylaigh-Taylor or a X E gradient drilt types.
The fluts approximation, which empiricitly neglecte
cleatric fileids parallel to the ambient magnetic field,
is esymptotically correor for long purpondicular wavelengths, if the perallel component of the electric field
is primarity inductive to electrate. However, when the
parallel electric field is primarily electrostatis,
there is a prolound reduction in the growth rate for
long parpondicular wavelengths. This reduction in
trouth rate eries because peraliel electric field driving
the instability. Ferallel electric field ariving
the instability. Ferallel electric field ariving
the instability. Ferallel clearity leds are more
likely to be efectrosistic in lower density pleasas than
is bighar density pleasas. Consequently, the antrepolarion of structuring from iow density pleasas, much
as loose found in the apread-F environment, to higher
Sensity ionespharic pleasas any not be reasonable.

J. Geophys. Pes., Blue, Paper 341476.

#### Particles and Fields-Magnetosphere

5770 interactions between solar wind and magestomphere DRMANIC VARIATION OF THE AUROBAL OVAL DUBING INTERSE MAGNETIC STORMS
C.-1. Meng (Applied Physics beboratory, Johns Hopkine University, leures, Heryland, 19101)
The herliudinal variations of the scot sertor polar cusp ecgios and the nighteide survoral oval term exacined during these intense geomagnetic storms to investigate the seroral oval dynamics. The variations error compared with the ring current intensity variation (i.e., l and with changes of the interplanative magnetic lield E. component to determine the dominant perenser of the large-stele polar ragion conliguration changes during segments acrosma. Devisional control of the polar rusp and the middight survoral oval from their cornal quiet time position are simple their cornal quiet time position are simple to the polar rusp and the middight survoral oval from their cornal quiet time position are simple to the polar cusp and the survey of the large-stele recorfiguration of the polar rusp magnetia with oit the squarorman solic oval occurs in coordination with the squarorman solic oval racovers more slowly than the polar cusp testion of a magnetic storms (3) the midlight survey oval end the moon sector polar cusp region move achieved the storm survey phens, and (4) the midnight oval end the moon sector polar cusp region move acheronity with the noundward varietion of the DO's, her of Auroral oval, polar cusp, magnetit store).

J. Coophys. Oss., Sius, Yapar MJ521

CHORUS-RELAIRD TIECTROSTATIC BURRES AT JUPITER AND SATURN

1. A. Bainleitnar (Max-Ylanck-toetitut fur Astronomis, FostYach 20, D-3411 Eastlenburg-Lindso, Garmanyl, W. S. Nurth, and Q. A. Gurmant

Analyses of the widehend plasma rave data obtained by Voyages I and it Jupiter and Barure have recently discovered at Earth in association with whistier-mode obscus, in all thrus magnetospheres the bursts eth characterfaed by sporadic malesions must or slightly helow the eleatron plasma Yraqosopy with bandwidths reaging Yras 10% to sore then 50% of the center frequenty. The seamls found at Jupiter occur in the middle angustosphere during both the degride as real as the actly marning peases. At Sature, the bursts occurred to the octer regions of the angustosphere during the daysldu pees. In such of the events earlysed, evidence calet for each wistin of the electromatatio hersts by a low frequency ware, promambif obscurs. One of the abscrattions gained at Jupiter includes the description of a low-Yraquascy band at the proper frequency for chorus. Butalled wasafors satiyis confirms that this band does, Indeed, modulate the electrostatic hursts. Based on the present understanding of the terrestrial chervations it is believed that the sleetrastic hards are generated by an electron heam (Siestrostatic botes, chorus, Jupiter, Sature).

1. Ceopium, Ros., 3110, Paper Jait53

5755 Piesma Instablilities
VELOCITY SHEAR INSTABILITIES IS THE AMISOLARPIC SOLAR
WIND AND THE MEALING OF TOMS PERPENDICULAR TO THE MAG-

1. Ceopitys, Ros., Sino, Paper Jait53

Wild AND THE SEATING OF TONS PERSENDICULAR TO THE HAGMETIC PIEUS

S. Rigiluoio (Sigh Aitiude Observatory, Nationel
Ceniar for Atmostpheric Research, Bouldar, CD, 80307)
The lieaze and quasilirer theory of perturbations
in fisito-5. colitatoniess plasmas, that incorporate
a theared velocity flow, is developed. A timp(s,
oss-dimensionsi asgnetic fisid geometry is assumed to
sus, i.s. et 2 , 0.1 AU. Inp modes are examined the
fitsil: an ion-acoustic mode (fisits-5 slabilized)
and a comprasional Aifven mode (fisits-6 thresheld,
high-B slabilization). The tole pleyed by equilitif of these modes, is also praceted. From the
quasiliner theory, the effects of thresheld, from the
collegerature amontopies, is the linear technical
city of these magnetic, field of the tolar wind is determined; qualifative sprompth with the observed an isoio the magnetic, field of the tolar wind is determined; qualifative sprompth with the observed an isoropies of electrons and ions, it obtained. The
salivation of these instabilities.
J. Geophys. San., Sive, Paper 121522

5755 interactions between solut wind and magnetosphere NOWLINEAR EVOLUTION OF MAGNETOPAUS: TEARING MORES

SYS interactions between solst wind and angertemperer NOXLINEAR EVOLUTION OF PRACTIONARY TEXRING MORREY. F. Y. Coronili [fhysics papertment, NGIA, Los Angeles, California Biss4] and K. B. Quest
Since the magneroshesth plasma is highly turbuient, reconnection at the dayside magnetosqueme is likely to be temporosily unsteady. The teaching mode can be viewed as a model for the unsteady development of a reconnecting anguarty lopology. Magnetopment after reconnecting anguarty lopology. Magnetopment tearing occurs in the guide-field ilate, and has a wove paciet spatial servicture in the cost-west direction. He solve for the nonlinear evolution a single wavelength guide-field teating rode including the effects of finite transit time on the Landau resonant slectrons. Short wavelength modes evolve alpobratically in the with perturbation amplitudes proportioned to 12. Long wavelength modes etc Guity nonlinear, and the amplitude grown ilmostly is time. [Magnelopouse, reconnection] J. Geophys. Pac., Sine, Paper Jai546

5710 Short-period lices than 1 deyl variations of magnetic field
A REZAMINATION OF ALS 6 HAGNETOTIKIES DATA FOR RADIALLY FOLDRIZED Pt 3 HAGNETIC PURBATIONS
Kanno Lakabeshi and Robert L. McPherron
(Institute of Geophysics and Pleanfory Physics, University of California, 100 Angelos, California, 9002t)

The polecisation of Pc 3 (2f-100 millifects in agnetia pulsations masured by the ATS 6 flugges ampenemence at synchronous orbit has been essained using dynamia eurospectral enalysis. In contrast to the result obtained by Arthur et al. (1217 using the same deta set, to find very few reses of radially poloriced Pa 3 palestions. We argent that estallite noise in the tadial component, which depends on irrequency is no 0.015/f (nl2/km) is responsible for this disegreesent. In the presence of this type of noise, disgonsilection of the spectral matrix can produce on erroneous major anis of polerisation. Host Pc 3 pulsations cinumified as radially polerised by Arthur et al. appear to be a consequence of smallf-amplitude enimuthel pulsations tontaminated by setallite noises. (Pulsation, magnetifield, polerises on anisones.) The poletication of Pc 3 (2f-100 millimotte nagnetia

5785 Whistions
EIP EMISSIONS two PELtlivisyIC ELECTRON FEECIPITALYOU
E. S. West (Geophysics Progres, University of Nanhingine Sealile, W 96195), D. K. Parks
Shunlisonows manurament of ELP emissions and
branseltshiung X-rays ware ands using a belicon-borns
amperiment Nieus from Velthanks, tiseks, on September
30, 1916. Seversi incanse sucresi 2-ray bersis of 2-3
minus dureyloo rere detabled wilds have been interpreted to be the resall of releivisetto election precipttalico (SEP). Simuliseasusly, the intensity of
ELY emissions lecreesed and was elec observed to here
periodicalise similar in these in the X-ray flux.
These combined massurements are evidence of magnetospheric wave-particle processes Contribuling to electrum precipitation. The presence of pulsations in the
prodipitating Yius is the only report of this majure
during reletivation precipitation. The data have been
compared with precipitation and modulation theories
and we note that the dels grace eithe codel in which
ULF modulation of the emission growth rate modure. It
to postulated that this ESP week resulted from ELF
wave and calculation interaction, possibly triggored by
the ULF commutence ratest than ditectly by ULFelectron interactions.
J. Geophys. Fus., Blue, Esper 3A1524

J. Geophys. Pes., Blue, Caper 3A1524

J. Geophys. Pas., Blue, Esper JA1524

2185 Whistlere
Miltyler INDUCEO SWPPRESSION of VLF NOISE
W. B. Roil (Space, Tolecombunications and Endioacluste Laboracovy, Siminot University, Stanford, California, 03091, D. 1. Carponear
Res ovidence has been tound connecting whistlets with transient reductions in the amplitude of magnetosphorft VLY noise bands. Until now, the only resported examples of such affacts were observed during a several hout paried at Siple Etation, Antarttics when bursts of perficie pracipiestion were correlated with whistlers that suppressed a background hise band. Date acquired at fourh Pole Station during 1981 showed similar suppression events on 20% of all winter days. A roview of data from Siple, Byrd, Eights, and Palmor Stations in Antartics and Robertal in Quaboc, Canada has since identified many more events. The ground signature of an event is cheraterised by the ettamusion of easieting VLF noise band following the orival of a whistler. The attenuation typically reaches a maximum of 3-5 dB in 3-10 seconds and the noise bend ratovate to the pre-event amplitude 15-30 seconds offer the whistler. The noise bands are generally sid-intitude hise, but suppression associated with polar chorus has been seen. Regularly observed features of suppression events includes multi-inop scholing of the driving whistler includes multi-inop scholing of the driving whistler the transitor of the whistler continuing suppression by the whistler echoes as the suppression during the lirer pass of the whistler continuing suppression by the whistler echoes as the suppression during the lirer than the suppressed noise; suppression by the whistler echoes as the suppression by the whistler schoes as history exercition of the whistler scho troin. Bose data suggest that this phenomenon may be a natural meelog of the previously reported Quiet Ecad effect le which signate that this phenomenon may be a natural meelog of the previously reported on signature. echalogi eophys. Pes., Elue, Pspor 161541

ALBEDO OF SOVE-CONTAMINATED SHOW

P. Chilek (Mailonal Center for Atmospheric Research,
Boulder, Colorado, 80301), J. hemasuage ed V. Silvesiava
We present a new codel of seaso Manidag impurities
ignaphicle carboel. Submicros soot particles are supposed to be distributed randomly throughout the volume,
or et lewet throughout a warface layer of a snow oryatal. Mises the mixing rule for e delectric constant
of a snow-soot mixture. These re proceed to obtain the
single scettering slabeds and sogmentry factor. Using
the detta-Eddington approximation re delerades refleclivity (albedo of a snow layer to the wavelongth range
0.3 pm \$ \$ 5.2.5 pm. Calculated spectral albedoe an
rell as the dedeced amount of graphitic parbon is 5n
good agreement with field onemurasconie. (Snow, sibedo,
graphillo carbon)
J. Geochys. Res. Crass. Pages 1610av.

7. Goophys. Res., Creen, Papet 101497

Georghys. Ess., Slan, Yepst 341421

5799 Camecal (Ionosphare)
ON THE EQUATORIAL COMPIRESHIP OF THERMAL PLANA
ONNERATED IN THE VICINITY OF THE SINGS OF EXTURN
W.-M. IP (Bus-Planck-Lastitut für Asranomis,
D-14:1 Satiemburg-Lindau, Inderel Sapublic of Carrany)
Consideration of the force helames of the ting plasma
generated by metangraid impact to the rotating jounsphare of Saturn is antended to include the angustic
mitroting affect. It is found that there are modifications of the so-called siphos flow limit derived for
charged particles with usro magnatic moment if the
ionesphasic plasma has a thermal temperature anosading
a few eV. The nature of the force betame is each
that, icetaed of a sharp division between complete
ions and amplete reshearption, a transition zone of
partial loss appears. If some of the insures the
rings are produced by ionisation of the neutral armosphere in the visinity of the ring system (slee
generated by anisomoid impact vaporization), snother
theoretical limit dividing the upward flow from the
equatorisity confiond notion is located near the observed boundary between the S ring and the C ring.
This new light is very sharp as raquired to explain
the S-C ring boundary, which has not yet hear explained
by gravitational thesty.
J. Geophys. Sec., 21an, Japot 161421

E799 Cenerui | Radiation Prom Bioctron Somma)

MADIATIDA FRAN FULSED RELETION BEAMS IN SPACE PLASMAS

E. J. Harter (Space, Toldcommunications, and Radianelegue taboretory; Stanford University, Streford,
Califoreis 94305] and P. M. Bambe

A theoretical scuty has been made of the electromagantic radiation arising from pulsed electrons behas by
observed spolissonic emission. The study estamone en
eleatron behas which has a well organized spacing the
tructure dejarcined by a fixed trajectory in a magnetic field and on/off pulsing severmed by the electron
sources. From inla-model, the electromagnetic radiation
is delogationed by adding scharantly the radiation from
sech individual electron in the halical arresis. The
radiation per unit frequency interval is desaratined, as
well as the radiation per only solid angle, as a
fuggles of both propagation and ray sealer, electron
and beam current, voitage, and pitch longing a selection
and beam current, voitage, and pitch longing a selection.

ted for a coherent pracers, it is found that his religion power varies as the aguars of the bear carret. The reliatively high efficiency of the bear in products a clear readjation is fillustrated by constitution, among others, of a 1 keV, 100 at bear used in four, among others, of a 1 keV, 100 at bear used in round evaporiments on the space shoulds. For these paraseters the intel related power per training it attends to a selected angles to be greater than it is the intel bears power carried as electron limelic mapping injuries of control bears appropriately interest of control bears, if addition, electron bears, space plans, coherent calcalon). Rad. Sct., Paper 351d31

#### Physical Properties of Rocks

6 itu Physical Properties of Rocks

PULK THERMELASVIC ATTEMAYION OF CONCOSITS ANDRUS

B. Dedimany Intvision of Applied Science, Kernel
Intversity, Cambridge, interactuactuality 201150,

E. K. Suzner, Jr. and S. J. O'Commail

A theoretical derivation is axis for the ellectin,

iraquoncy-dependent thereoglastic bulk morning B = ## er de lectropic composite subjected to hydrestille etross os h. produsing volumetric strain \$5.1. \$5 host transfer is permitted to decur at the corr boundary of the compusite, but as a consequence of differential heating, best frameier stoom the equationate, and hunco dissipation, occurs in he intuity. Thus between the limits w= 0 cod w==. I (a) is complex and the thermodestic damping any be besent by Ug = | mis )/fa(K | . Paramercia studies show the by Vg = Inia )/Ea(K i - Paramerch stodies show he influence of various steario and therms properties or thurnsofestic dauping. Sumerical tailulations are made for a hypothetical lower-mantic sweedings of attainwite and magnesiouvistics. The results show in theresolastic disciplation in the lower morie as account for the shearest extensuation of the locitary radial nursal mode, and can elso provide instanting constraints on grain since. (Butk estimation, composite rocks, thermoelestic estematical).

J. Goodwe. Can. Rad. Paner Builds

bild Electicity, Fretturs, and Flow POINT DEFECT CHEMISTSY OF MIMERALS UNDER A STREETING ENVIRONMENT

POINT DEFECT CHEMISTS OF MINERALS UPDER A BUNDERED ENVIRONMENT

H.E. Sobbs (Earth Saisness Department, Krash University, Clayton, Vittoris, 1166, Australia)

The kinetice of rock/water interactions are sufficiently rapid that cost bydreabered system is marure will be in equilibrium with the edjaces rock mass. The bulk rock chemietry bulks to depart on the cost of the cost bydreabered systems in which only water, oxygen and hydrages for a given pressure and temperatus. Systems in which only water, oxygen and hydrages are present as fluid phases are considered byte. Varietions in the fugacity of oxygen by several other of magnitude are possible locally, controlled by voriations in the fugacity, controlled by voriations in local rock chemistry; these lead to reletive small varietions in the fugacity of water that is capiled acting as an acceptor into milicains leads to sirrel dependence on the fugacity of vater is capable of applicating the byterlytic vocalening effect but is recoff the arrong dependence on caypes fugacit; is nearly estable alone to raised whether it is an agree of foct that is observed in the classical hydrolytic vocalening grace about a size or raised whether it is an agree of foct that is observed in the classical hydrolytic vocalening affect but is a surer. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water. Examples are given for large and the process of water. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water. Examples are given for large in the fugacity of water.

L. Rouphys. Ers., Rod, Eaper 381481

500 IN WISEEMING OF BEAVITREE QUARTITES FREIRMIT REBULTS
O. Jeoui (Laboteloire de Diophysique sy Giofgania Interes, Université Peris-Sud, 91805 Gray, franci Interes, Université Peris-Sud, 91805 Gray, franci Yhe electronic band structure of quartz is sinch the presence of email amount of legarities such a summan transillos assists atteits of you. Silica end oxygen selddiffuelon are enhanced by an inertal but the concentration of leniese defects each en carginary oxygen vecsonoles or eliion intermitials due to Scattling se a cheijos electronic acesptor. Sadjes, by confreet, is a challow electronic door and retail in oxygeo vecencies or cition interatitis on the coting es a heife e sistronic acceptor. Soice, it convices, it convices the series of the soil of the conviction of the

6190 instruments and techniques
SLATISTICAL DETERMISATION OF OROPRYSICAL WILL IN
COMPONER FUNDLIONS
Eugene A. Howal (Morethen Did Company, Benver Beard
Center, 7.0. Sex 299, titleren, CO BOIGO)
The vertical response function of induction togeth
tools is shown to be derivable yrms a power testing
analysis of the measurement. The varidat response
that therefore is no hur the tool combines to set
that therefore is no hur the tool combines to set
that therefore is no hur the tool combines to set
that therefore is no hur the tool combines to set
that therefore is no hur the tool combines to set
that therefore is no hur the tool combines to set
that therefore is no hur the tool combines to set
that therefore is no hur the tool combines to set
that longing is a ilour, convolutional oparities
that is not searth's tenductivity profits of
the analytic process. The probabilistic companish
fleshed out by reasonably based excusping the
theapse accoss them. Erough together, that take
though as a const them. Erough together, that take
that is not e extinency process, but rither that
in not e extinency process, but rither that
in not e extinency process, but rither that
and the masurement and the system convolutions
of the ansurement and the system companies of inserting
that ansurement and the system companies of inserting
if the ansurement and the system companies of inserting
the second that the convolutions are shown unlog these ideas. The entry is
presented in general terms for possible distrupresented in general terms for possible distrupresented in general terms for possible distru-PEOPHYSICS, VOL. 48, NO. 11

6199 Cembral (Marina Sediments).
THE RFFECTS OF BTOH PRESSURE-BION TEMPERATURE IN
SOME PHYSICAL PROPERTIES OF OCEAN SEDIMENTS
Rogar Borle and Armand J. Silva (Department of General
Regimenting, University, of Shods Laised, Finghton,
RI 02581].

Engineering, University, or smooth and the process of the control of leberatory experiments was chickens with four mean endiments, two bloggeds contained with four mean endiments, two bloggeds contained and the conductivity ages along the control of the control

profile a settiffactory solution to the conflicting data dish as sife between the pore salur subscitics in-facted iron non-ficear thermal profiles of a can acdi-mate mit these Yiuid velocities derived from purer's lessed leberatory pureability data.

the effects of cleable variations in pressure and expetters upon nedecont thermal conductivity are stood to cleably reflect the behavior of the conductivity of the inquity of the stood conductivity of the stood conductivity of the stood conductivity of the conductivity of the stood conductivity of the calculation of the stood conductivity of the stood conduc

#### Planetology

Sin kneshares of Flances

Engine Copy Privile, Verrices on Mass

L. ign and R.G. Lucich Hearth Relance Department,
California State Control of Pail Partme, Pail Partme,
California, 925319

This paper presents the results of a study of local
service, and deat davils, on Mars as observed by
Unity Landes b and 2. It to bound that those
various involve wind spasse which may raine dust from
the matter markets. There is no indication that those
patible dust Couris contribute to the pinnet-wide
types at taker dust storms. Somewer, it appears that
the Table in maintaining the atrophantic dust
course. The data indicate that there is no preformes is metalice direction, as locate to core dismosters

190 increspending to a register of this work of of 300 a icorresponding to a request of inituonce of ster i in distant. There are subserve, Ouet devile. L. ferfin. Sec., Groen, taper 3:15 to

EWO Determ of Rosal

15 THI MED 15 THE RADIUS OF A HIGHLY

ELECTRICAL CONNECTING LUMAN CORE

1. L. S.W., L. L. Rock, J. Rorbert, and C. P. Sonett

iture of Placestry Laboratory. University Ol

trices, Farra, altona S57211

Matter, Farra, altona S67211

Matter, Farra, altona S67211

Matter, Farra, altona S67211

Matter, Farra, altona S6721

Matter, Farra, Matter, Farra, altona

Matter, Matter, Farra, altona

Matter, two Reduction, expendic floids). Liryky, Ben., Rud, raper 305116

The state of the s Sichs sinking during one formation and classified sinking take the core, provide a deep location rectained of bylone from the brettle. However, these fiching the suplain here the silicals and metal fiching in behave it of the rectain the suplainable could be supported in supertinated can be supported to the superior could have failed to express to a deep. infreeded anxiety fatter to segregate for desidents origine to wholly entisfactory. Lizzija. Red., Red, Yaper 385046

EMO REMOTELAS

LONGIA, AND PRYSICAL STUDIES OF TYPE 3 CHOMORATES:

2. REMOTERNITESCENCE OF SIXIEEN TYPE 3 DROHMARY

GOOGLIUS AND RELATIONSHIPS WITH OXYGEN ISOTOPES

AND RELATIONSHIPS WITH REPORT OXYGEN

AND RELATIONSHIPS WITH REPORT OXYGEN

AND REMOTERSHIPS WIT

the second secon 7. Cophys. Res., Sed., Peper 38502).

18 1. W. C. C. C. C.

A THREE-DIMENSLORAL STUPY OF METAL CRATES IN EQUILI-FRALLIS, "REGINARY CHOMPRILES A 1881-DIRESTREAL SUPY OF METAL CHAIRS IN DQUILLPRALLY, "NEURARY COURPRILES
Living and Pinterials Engineering, Lebigh University,
Bethichon, remmayivania, 180151.

Pethichon, remmayivania, 180151.

Pethichon,

J. Camphya, Rod., Rud, Paper 385011 ASIO Referrition

25A1-PRODUCTION PATES AND \$5pp/28A1 PRODUCTION RATE
RATIOS IN MCMATTARCTIC CHRYDDINES AND THEIR APPLICATION
TO GOMERANOMITH HENCOMES
U. Hurpers and P. Englett (Institut for Kerncheele,
Universität au Yolm, 0 5000 Kölm-1, heat Germany)
The tohy-lived spallogenic redicented for a separate of
Nomeric systematically studied in a large number of
nomentarctic meteorites by nondestructive procedulardence technique and neutron ectivation, respectively.
From the 25A1-Activities normalized to the main targer
olumnor, silicon, an average production rate of 299 \* S5
Idpn/kg 31<sub>mgal</sub> was derived. Seased on 15 chondrites with
expecture ages : 12 x 10°s and depth profiles of Dourmsals and Teyon, an average production rate ratio [35My
25At[prod = 1.40 t O.15 [dpm/kg fe/dpm/kg 51mgu] was
calculated, which seems to be depth-independent for matonities with prestrosphoric radii 8 \* 15 cm. 3 Mm/Esl
tadiation ages for 27 stones with whort exposure ages
were determined. A comparison of our results with the
respective 5 Nm. and 1 Mm-exposure ages generally shows
a good agreement. The commit cray boths fuser age acoin
covered by this method is 1 x 10° · Y<sub>rad</sub> · 10 x 10°s.
tChondrites, committed and the second of the second of the second of the production ratios,
production ratio ratios, exposure ages;
J. Geophys. Pos., Ped. Paper 485001

6560 Arteorities (Bostotte Choodrites)
IMPACT MBLT-POCK CLASYS IN THE NV17113 ENSTAINTS CHONORITE BESCHAL LEPLICATIONS POB A GEOSTIC PSIALLOSSKIF SEYMEN EL CHONDRILES AND ABBIYES mitheonian institution, Wosbington, A.C.

The Hyttels unstatite chondrite breccia contains 518 wolf dark clasts which appear to be impact calls to the largest clast Clast AV is 2.5 on in diameter; it has an igneess testure, no chondrules, and is depleted in metallic Fe, Ni and sulfide. Its fine grain sizu, low-DI benedite and schreib-ersity, and rare narrametro resulted from rapid coaling. The abundance of melt-rock classes in Noittle suggests that the brecch resided at its parent body surface.
However, the apparent absonce of El chond-rites with solar wind-implested rate gases suggests that the El parent body was row small to develop a substantial regulith. The bulk composition of Class A is very einitar to that of average autritum, or option a seven-toid containent of 5. Cr., and Thems eluments are concentrated in the was degived from one of the soffide-rick rustons of the living matrix. If an, the ambittue may be genetically rotated to the chondritus. (Bruchla, aubrites, impact

J. Geophys. Pos., Rod, Paper 385008 5560 Horoorteice EXPERIMENTAL STUDY OF SECRICATION IN PLANE EPONT SOLIDITICATION AND ITS OFTENANCE TO DRIVE HELD ONLY

SOLIDITICATION

SOLIDITICATION

R. Solizauthu and J. I. Coldstein tooth. of Stallury

Solizauthu and J. I. Coldstein tooth. of Stallury

and Materials ingineering, Whitner Lab 25, tehigh

University, Schileben, SA 180151.

A directional solidification technique was developed

and applied to the problem of iractional crystallisa
tion of an iron meteorite poront body. Samples of

Fo-Ni alloys close to meteorite compositions, and con
taining S, P, and C were made. The soliditied struc
tures contain secondary phases such as sulphides with
in the prosutactir single crystal susteed to (toolte).

As a result of thuse experiments, we propose that the

secondary phases observed in iron moteorites ters

lormed during primary solidification of sustenite

itemeico). The beauved composition patellies of Ni, y

and C in the slidys were used to explain the alemental

distribution within a chemical group of iron moteor
itos. As analytical procedure was applied to dotsr
minu the equilibrium distribution coefficients of

si and P series with provious values. These distri
suction of fractions solidification coefficients

of Si and P series with provious values. These distri
suction of the sisembaid distributions in iron

matorites. (distribution coefficients, item mator
ite, directional solidification.) to, directional colidification. 1, Geophys. Pos., Red, Paper 185010

PIECE OF THE ANCIENT LUGAS CRUEY: ACTS AND COMPOSITION OF CLASTE IN COMMOSTION REECTIA 67012

8. Mart [Chemistry Department &-Oil, Solversity of California, 2003], U. Asachimana, F. Estarbadt, J. Geiss, S. Ordgler, O. I. Jost, J. C. Loui, H.-S. Ne, N. A. Schmitt and C. J. Tagior No discuss the composition and chromology of class representing three misot lithologies in tossartium braccis b7015. The lithologies studied are: south force gabbro, pristing troctalith macrothesite (67811,20), and geomulate troutofith asorthouse (67813,20). These lithologies were presumed to represent samples of the ancion lumat crust. The pristing anothesite rate, contains little or so trapped liquid considerate with its two-phese mineralogy. The plagioriess apparates been \$78,x^{-38} a placens gens of 4,10 2,000 h.y., sod a finel rise in the age pettern say represent a "manary" of the carlier avoisting. The groundlist choich little sorther viole studies between the specific and the studies between the studies between the studies and the studies between the studies and the studies between the studies are studies are studies are studies between the studies are studies. The studies are studies. The studies are studies. The studies are studies. The studies are studies. The studies are studies are studies are studies are studies are studies are studies. The studies are studies are studies are studies are studies are studies are studies. The studies are studies are studies are studies are studies are studies are studies. The studies are studies. The studies are studies. The studies are studies. The studies are studies are

J. Geophys, Res., Red, Yapor 185054

### Seismology

6950 Satemic Sources
CCI STRARNTS ON PLATE MOTIONS IN SOUTHERN
PAYISTAN AND THE NORTH-ERN ARABIAN SEA FROM THE
FOCAL MECHANISMS OF SMALL EARTH-GLIAKES
FLC Guittmeyer (Woodward-Cryde, Consolitanta, Wayne, N3
0/470), A.L. Kafka
The focal machanism and depth were determined for eine
small earthquakes (M<sub>2</sub> < 10° dyna-on, M < 5.5) that becurred
in earthquakes (M<sub>2</sub> < 10° dyna-on, M < 5.5) that becurred
in earthquakes (M<sub>2</sub> < 10° dyna-on, M < 5.5) that becurred
in earthquakes (M<sub>2</sub> < 10° dyna-on, M < 5.5) that becurred
in earthquakes (M<sub>2</sub> < 10° dyna-on, M < 5.5) that becurred
in earthquakes and the northern Arabina Sea from us
earthquake that first-mallon date. Focal parameter
ware determined from the Rayletin dates by using an eventpair method of enalysis. For earthquakes that he located
vety alose to each other. (< 5.0° hmb, the event-pair method
to still in remove a elogificant proportion of propagation
effects are reduced for only the largest from the propagation
effects are reduced for only the largest devices for a
model of plate interections in the vicinity of the, southern
missions principle ignotion. The Owen frective come is a
mission principle ignotion. The Owen frective come is a
mission fault that decommodities right-learnity motion
between the Index and Arabian plates. The plate betwienday
in the vicinity of the Macray ridge is also pertelly justing up
in the vicinity of the Macray ridge is also pertelly justing up

When was the last time you heard of prices going down - or for that matter remaining the same? Not often enough, right?

AGU has held the line on these 1984 journal prices.

## Geophysical Research Letters

Editor-in-chlef is James C.G. Walker, Space Physics Research Lab, University of Michigan

Same price as last year \$22 (U.S.) \$27 (Non-U.S.)

Geophysicai Research Letters is published monthly. GRL contains reports of the latest research geophysics — papers are published 9 to 12 weeks after receipt of manuscript. GRL has only peer reviewed papers, with full author and subject indexes at year's end.

462-6903 (local)

TOPLACEYOUR 1984 SUBSCRIPTIONS

WRITE: American Geophysical Union 2000 Florido Avenue, N.W. TWX 710-822-9300 Washington, DC 20009

of transform asgments that strike subpersited to the Owen fracture some. Spreading contons may also exist in the vicinity of the Nurray ridge, but were not decumented by sets of the other exidence. The site azimuths for earthquakes along that boundary are significantly more northerly than those predicted by vertices regional and world-wide models of plate motion. The Arabian plate is being subducted beneath the Furnalan plate along the boundary lend north-northeasterly in general agreement with predicted directions. Lell-internal mellon is documented along the boundary between the builture and Eurasian plates in southern Paristan. The predicted direction of relative motion between these plate is not significantly different from that observed. Two of the cathquakes studied appear to be interplate avent, which may have occurred within the acceptionary prism along the Makran coast, however, is based on limited date. The other interplates as orthquakes occurred within aedimentary deposits. ntrapiets certifiqueto occurted within sedimentary depositions the western edge of the indice subtontinent react the indice. Europian plate boundary. (Surface wares, Pakista

6050 Selemic Sources Linear Moment Tensor Inversion for Shallow Thrust Fabiliquakes Compuling First-Motion and Surface Wave

EMETAR COMEST 145506 EVERSION FOR SIGHALDS TREAST BARHQUAKES COMMINIST FIRST-HOLION AND SURFACE WAVE BAIA Andrew 2 Michael ( Oupariment of Geophysics, Stanford University, Stanford, California, 94305) and Robert J Geller We derive a linear moment Lenaer inversion method (which we call sace t model plane Inversion) for obtaining a double couple for mechanism when one nodel plane is moved. This typically is the case for shallon thrust avents, for which anly the siscply dipping nodel plane can be determined irom telescismit first motions, conventional moment Lenaer inversion methods are known to latif for those events between the portion of the moment lenaer corresponding to vortical dip-silly issulfing is surfamely inofficient in catalling surface waves. In this paper we invert long period (256 sec) undermental mode Rayleigh waves from the BDA network; the inversion inchinique can also be applied to body wave amplitude data or to entire records (as a sum of normal modes), given the approprialt normal equations.

Fe study saverel shallow (h < 30 km) thrust carthquashes for which the stepty dipping nodel plane are easily be found from body were first motions. In contrast to elandard nutinos wave momental tensor inversion techniques, which have serious stability problems for such sizilow avents, our tachrique successfully finds the scalar moment and agoond nodel plane. (Salamio sources, surfaces wares, testruments and inobniques).

J. Coophys. Res., Red. Paper 181510

Social Sciences

1310 Economica ESTHANYING DEMAND FOR INTAVA WATER BY SELF-SUPPLIED CHOME Joseph A. Ziegist (Zeonomica Department, University of Arkanasa, Payottavijia, Arkanesa, 12701(, Stephen S. heii

The proper specification of price variable is satimution the demand for intaha water by sati-supplied
lirus is a neglected subject to the literature. Fravious studies bere used assentes of everage cost, but
macciassital accounts theory organes firms respond
to arginst costs. Uning data from a sample of paper

性域所的。然后,被使的特

A 35% aavings over last year \$16 (U.S.) \$20 (Non-U.S.) This journal, published quarterly, contains papers that distill previously published scientific work in currently active areas of geophysics and space physics.

Review of Geophysics

Edited by James Heirtzler, Woods

and Andrew F. Nagy, University of

Hole Oceanographic Institution,

and Space Physics

Michigan

Now all members can afford to have Review of Geophysics and Space Physics in their personal research libraries. This Union-wide journal of pertinent review articles has been specially priced.

TO EITHER OF THESE JOURNALS: CALL: 800-424-2488

esticate the Leaporal behaviour of the uitraviolut enissive between 600 and 300 ne, resulting from changes throughout the enist cycle in the active leatures on the

disc. These calculations suggest that for solar cycle 4 the flux variability at \$00 to 14.23, decreasing to 100 to 14.23, decreasing to 100 to 14.25 mg, and to 23 to 100 and.

No. Vitraviole: flux variability of this cagnitude ng. Ultraviole: flux variability of this magnitude corresponds to an average increase in the total smiss irradiance from 1976 to 1979 of about 5.05%. For comparison, the swerage reduction in the total solar irradiance from 1576 to 1970 due to summpt blocking is 0.0ff. Because of the enhanced ultraviolet emission from solar active lemittes, the variability of the total solar irradiance during cycle fits predicted to be less than is calculated by models which consider only the olifocts of sumspot blocking. This result is consistent with the need for an added faculae brightening term in total solar irradiance models.

Volcanology

entry voicanology lopics
EROPYLOY CORLASSING AT FILAURA VOICANO, HAWAII
F. W. Kielin (U.S. Goulogical Bur.eg., 1-5 hiodicitely
20., MS-71. Monio Park, CA 94025)

Obts from a network of selectments, a lilitater
and the pattern of summit inflation between supplican
have onde quelitative staption forecasting possible
on Eliance voicage for ever 20 gears. Yhis payet
Yormulates quanificative insecusing by calculating
the probability of an enuprion based on turran
levels of tilt, tilt rate, sefacicity, and fortsightly tide. Elect of eruption based on turran
levels of tilt, tilt rate, sefacicity, and fortsightly tide. Elect of eruption probability at a
function of various parameters are derived using a
set of 20 eruptions during 1984-19. Whe mathod toets
the pracuracry signiffactor of various parameters
over different tips smales and determines probability
tiles by comparing date before amptions with data
values generally. Iffic level is an evuption pracutant
fignificant to better than 9.9% when avaraged over
any interval from 1 to 20 dags. Tilt rate is a
precursor significant to better than 99% why, hat
solve lo the date reguless that it be avaraged over
10 days or more. Estribundant are a short-sem
pracursor significant to better than 98% when
everaged open 1 to 10 days for inger anothquahes
next the summit calders, and over 5 to 20 days for
vary small marchquakes withig the selders. The
Yorknightly modulation of tids infinences cruption
probabilities are independent of the class elapsed
atnes the less emption. The eruption probability,
when tanted eigness the serverion record 7 tom which it
was derived, Is significant to the 99,184 terel willow
compared with tendom guessing. Segoing 1-day, 7-day,
odd 30-day Yorecasted are calculated by tumputer it. was Aerkand, is significant to the 99.881 term when compared with tendos guessing. Sugging 1-day, 7-day, and 38-day Yarteseate are relevanted by computer at the Essuitan Molesso Observatory and supprissent the qualitative interpretation of geophysical data.

J. Geophys. Res., Sad, Paper 381851

#### General or Miscellaneous

orse Techniques conlicable in BOCE MAXIMUM ENTROPY STECTEAL ANALYSIS OF ARTIFICIAL SIRUSOIDAL SIGNALS M. Velianto (Islituto di Fizica, Università do 'Aquila, 67100 l'Aquila, Italy), and U. Villants
We applied the Surg's signification to The

was concerned and securities and the security of the security

. .